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UNITED STATES NAVY
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THESIS

DECISION ANALYSIS APPLIED TO THE
DEPLOYMENT OF
MODULARIZED OCEAN BASING SYSTEMS

by

Robert A. Reifenberger

September 1993

Thesis Advisor: Kneale T. Marshall

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The decline in the availability of U.S. bases overseas, accompanied by rising permit costs and operational restrictions at remaing sites, has led to the consideration of ocean-based support sites as an alternative to nd-based systems. Specifically, the Carderock Division of the Naval Surface Warfare Center (CDNSWC), Mobile Support Systems Program Office, is conducting a feasibility study of Modularized Ocean Basing Systems (MOBS). Attendant to the development of these high cost, limited availability systems is the requirement that selection of deployment sites be conducted with the goal of maximizing their effectiveness. This thesis employs the methodolgy and practice of decision analysis to develop a pilot model for assessment of potential regional deployment sites. Key factors incorporated into the model are the uncertainty associated with the availability of Host Nation Support and the possible escalation of hostilities. MOBS and Host Nation support effectiveness are measured in terms of capacity and the number of channels available for the flow of personnel and material, modified by the likely support system degradation inherent at higher levels of conflict. Costs associated with the respective systems are incorporated. The decision maker is provided an evaluation of the impact of different MOBS deployment policies and insight into a number of related issues.

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Decision Analysis Applied to the Deployment of Modularized Ocean Basing Systems

by

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Submitted in partial fulfillment
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ABSTRACT

The decline in the availability of U.S. bases overseas, accompanied by rising permit costs and operational restrictions at many remaining sites, has led to the consideration of ocean-based support sites as an alternative to land-based systems. Specifically, the Carderock Division of the Naval Surface Warfare Center (CDNSWC), Mobile Support Systems Program Office, is conducting a feasibility study of Modularized Ocean Basing Systems (MOBS). Attendant to the development of these high-cost, limited availability systems is the requirement that selection of deployment sites be conducted with the goal of maximizing their effectiveness. This thesis employs the methodology and practice of decision analysis to develop a pilot model for assessment of potential regional deployment sites. Key factors incorporated into the model are the uncertainty associated with the availability of Host Nation Support and the possible escalation of hostilities. MOBS and Host Nation Support effectiveness are measured in terms of capacity and the number of channels available for the flow of personnel and material, modified by the likely support system degradation inherent at higher levels of conflict. Costs associated with the respective systems are incorporated. The decision maker is provided an assessment of the impact of different MOBS deployment policies and insight into a number of related issues.

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EXECUTIVE SUMMARY

This thesis is an application of probability-based decision analysis to the deployment of Modularized Ocean Basing Systems (MOBS), a proposed alternative to foreign territory-based logistics support sites.

The decline in the availability of U.S. bases overseas, accompanied by rising permit costs and increasing operational restrictions at many remaining sites, has led to the assessment of ocean-based support as an alternative to land-based systems. The Carderock Division of the Naval Surface Warfare Center, Mobile Support Systems Program Office, is conducting a feasibility study of MOBS.

MOBS are composed of semi-submersible platforms similar to those common in the off-shore oil industry. Construction methods are based on existing technology and the primary construction material is prestressed concrete. Experience in the oil industry and tests conducted to date indicate excellent survivability in extreme marine environments. A MOBS on the order of six modules (providing weather deck space of 300′ X 3000′) would support C-130 aircraft variants and provide combined liquid and dry cargo capacities of up to 183,000 short tons. In short, from production, sustainability, utility standpoints, MOBS is a viable platform.

It is likely that MOBS would be available in limited numbers due to high production and deployment costs. The state of the overseas basing network is such that the number of deployment

sites would exceed MOBS availability. Advanced planning on placement of MOBS is necessitated by MOBS' limited mobility. These factors indicate the need for a rational and defensible means of assessing alternative deployment sites.

The advantage of probability-based decision analysis as a means to fulfill this need is the ability to incorporate uncertainty, a key factor in the site selection process, along with strictly deterministic elements into the model.

The uncertainties providing the foundation for the model in this thesis are those associated with the availability of Host Nation Support (HNS) and the likely status of hostilities or conflict level in a given region. Relationships are established via influence diagrams and decision trees. Results are measured in terms of cost and effectiveness.

Three scenarios, based on varying conflict level probability distributions, are employed to exercise the model. Within these scenarios, three characteristic host nations are described, each having different capabilities and each varying in the likelihood of providing those capabilities in support of operations against a given hostile state.

The decision model is implemented utilizing two different types of software to demonstrate the portability of the model. First, the model was constructed in a standard spreadsheet (Lotus or Quatro Pro). Secondly, commercial decision analysis software (Decision Analysis by Tree Age) was used.

Analysis of model output provides a description of the

decision space associated with trade-off variables,and the simplicity of the model allows a rapid assessment of "what if" excursions. The decision maker is provided a description of the impact of differing MOBS deployment policies in lieu of point estimates.

The model, as it has evolved, is envisioned as a supplementary analysis tool to be used in conjunction with other methods. Additional levels of complexity can be introduced into the basic model as desired.

I. INTRODUCTION

A. BACKGROUND

A feasibility study of Modularized Ocean Basing Systems (MOBS) is being conducted at the Carderock Division of the Naval Surface Warfare Center (CDNSWC) as a result of the Mobility Requirements Study and at the direction of Congress. The thrust of this study is the investigation of offshore basing systems as a partial solution to problems associated with forward basing on foreign territory.

Representatives from several affected Department Of Defense agencies screened a number of contractor-proposed concepts for MOBS. A Brown & Root, Inc. concept, exploiting existing semi-submersible oil platform technology, was deemed the most viable and was selected as the basis for follow-on study.

Figure 1, on the following page, illustrates the Brown & Root concept. It consists of semi-submersible platform modules linked on-site to form an active support base with many functions inherent in an overseas basing site.

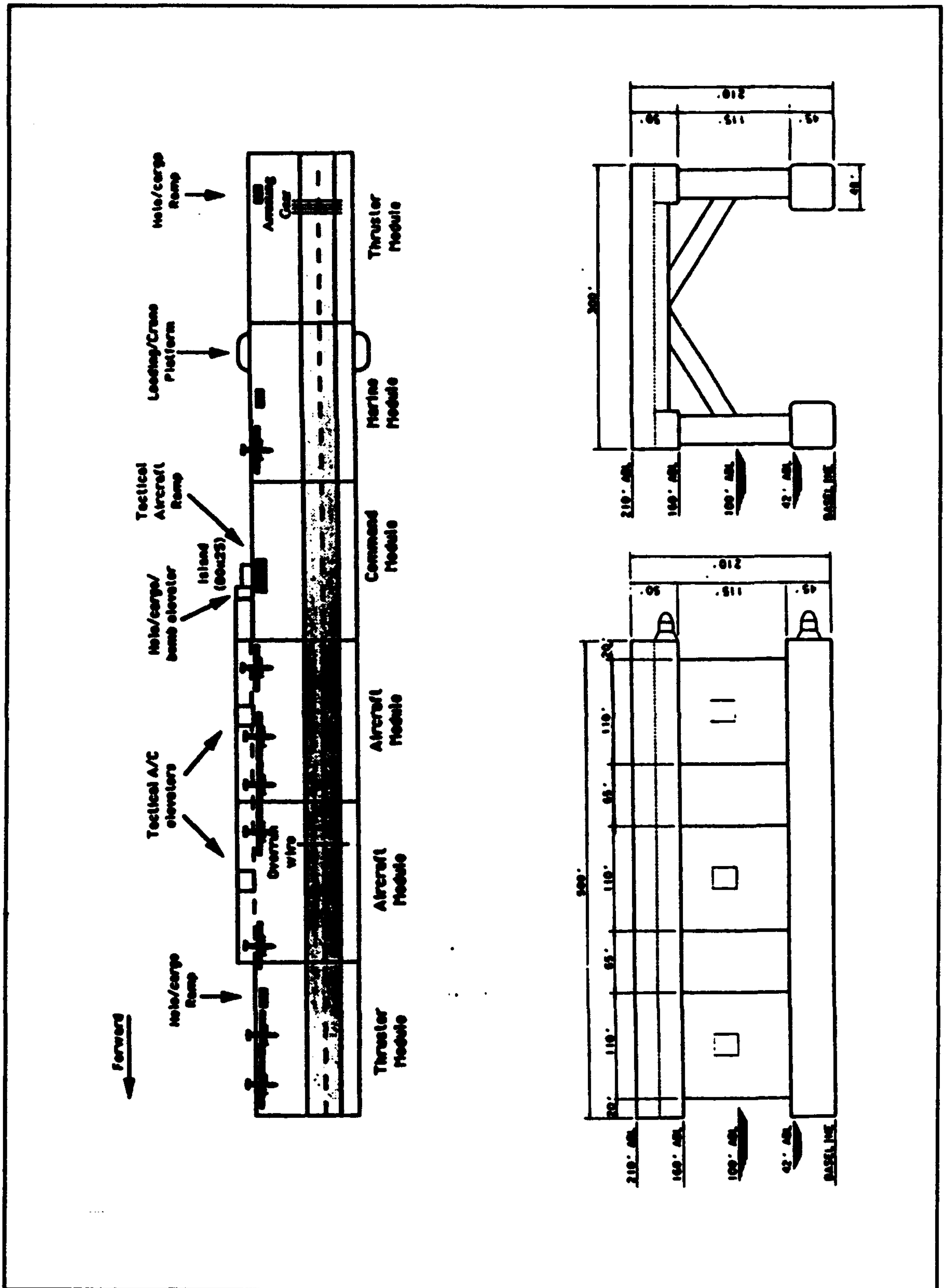

Figure 1 Brown & Root, Inc. MOBS Multimission Concept.

The scope of possible operations and functions depends upon size and configuration, which can be tailored for specific missions. These functions include, but are not limited to:

- Petroleum, oil, lubricant (POL) storage/transfer
- Dry and refrigerated stores
- Ordnance stowage
- Air strip capable of supporting C-130 variants (C-130E airlift, KC-130 air tanker, etc.), STOL (Osprey) and vertical lift aircraft
- CVBG support
- Air/surface/subsurface unit repair capabilities
- Amphibious/Special Warfare operations support (personnel & material)
- Ship and aircraft repair capabilities

Pre-stressed concrete is the primary construction material for MOBS. Comparable existing concrete structures have survived continuous saltwater immersion well in excess of 20 years. MOBS would have an intended useful life of up to 30 years.

Current studies indicate that, even in under what are defined as "survival conditions" (significant wave height of 50 feet), the MOBS maximum single amplitude roll angle response is less than 5 degrees, pitch response is less than 10 degrees. A sea base consisting of several modules will

have negligible pitch response in sea states less than survival conditions [Ref. 1].

MOBS exploits existing technology and is composed of readily available materials. In short, MOBS is a potentially viable system capable of fulfilling multiple peace and wartime missions.

B. MOBS: A HISTORICAL PERSPECTIVE

As early as 1928, open-ocean structures were explored as a means to refuel trans-Atlantic flights (Armstrong Aerodromes). Artificial island construction was revisited to a more extensive degree during World War II. The U.S. Army revived the Armstrong concept and sponsored extensive analysis and tests including large scale model seakeeping trials. This effort waned with the advent of long range fighter and bomber aircraft.

At Winston Churchill's direction, prototypes of tethered platforms for deployment in the English Channel were developed. These platforms were envisioned as forward-based air defense and recovery fields.

Floating logistics centers were created by the U.S. Navy during WWII by congregating a number of supply, repair ships and barges at a common anchorage. These units were connected via a network of causeways, ramps, and communications links providing what was, in effect, a single complex.

In the early 1960's, the U.S. Air Force sponsored a study to investigate the feasibility of constructing high stability seaborne platforms for range instrumentation. Other projects in the 1960's included a Brown & Root, Inc., study into the development of a semi-submersible platform for support of the MOHOLE program (a project to study the properties of the Earth's mantle). That concept was the precursor to that displayed in Figure 1, the design assumed for this thesis.

From 1963 to 1966, the U.S. Navy sponsored a feasibility study of a Floating Ocean Research and Development Station (FORDS) which determined that a semi-submersible configuration would be the most viable platform. The Rand Corporation conducted an extensive study in 1969 which drew on advances in the offshore oil drilling industry to explore man-made ocean platform concepts.

In 1970, the Naval Postgraduate School was awarded a contract to conduct studies on operations research aspects of MOBS. The Naval Civil Engineering Lab (NCEL) released an exhaustive study in 1971 entitled *Mobile Ocean Basing Systems - A Concrete Concept*. The platforms envisioned in this study were modular semi-submersible platforms combined to form open ocean multi-functional complexes as large as 1000 feet by 4000 feet. NCEL revised this concept in its 1989 report Modularized Ocean Basing System - A United States Option in a Strategy of Discriminate Deterrence

(Circa 2000). This investigation centered on the feasibility of floating bases as a practical alternative to diminishing U.S. foreign basing assets.

This role, that of providing alternatives to overseas land-bases, continues as the primary motivation for the current level of interest in MOBS. This aspect is explored in detail later in this chapter.

C. INTERNATIONAL LAW OF THE SEA

Articles 55-75 of the 1982 United Nations Law of the Sea (LOS) Convention establish a 200-mile Exclusive Economic Zone (EEZ) in which a coastal state has both certain sovereign rights and special rights with respect to activities undertaken for the economic exploration and exploitation of the zone. Within the EEZ, a coastal state has limited jurisdiction with regard to the establishment and use of artificial islands, installations and structures.

The coastal state has the exclusive right to construct and regulate the construction, operation, and use of any artificial islands, and of any installations and structures for economic purposes, provided that artificial islands, installations and structures may not be established where they will interfere with the use of recognized sea lanes essential to international navigation.

The coastal state has exclusive jurisdiction over such artificial islands, installations, and structures including

jurisdiction with regard to customs, fiscal, health, safety, and immigration laws and regulations [Ref. 2].

Due to unresolved reservations of the Reagan Administration, the United States was not a signatory to the December, 1982 United Nations Convention on the Law of the Sea. However, in 1983, President Reagan proclaimed a 200-mile wide EEZ, in terms consistent with the Convention, and promised that the United States, subject to reciprocity, would respect similar zones established by other states.

Nearly all provisions of the LOS, particularly those relating to international navigation and the rights and duties of coastal states, have become customary international law and, as such, binding on all states whether parties to the Convention or not.

The acceptance of the EEZ and associated tenets of the LOS are the impetus on MOBS peacetime deployment restrictions to ocean areas beyond the 200-mile limit. As such, MOBS can be operated free of restrictions as long as freedom and safety of navigation are not impeded.

D. MOBS DEVELOPMENT MOTIVATION

Two factors concerning the current overseas basing system compel the development of MOBS: rising costs and operational freedom.

1. Overseas Basing Costs

The Hudson Institute's *U.S. Global Basing Study* categorizes overseas basing costs as either fixed or permit [Ref. 3]. Fixed costs refer to money that goes directly to build and maintain the facilities and installations of a given base. Permit costs refer to monies paid to several host nations for the "privilege" of building and maintaining facilities within their territorial borders.

Determining fixed costs is relatively straight-forward. Permit costs are somewhat less simple to evaluate because these costs are not strictly labeled as such. Often, the negotiations for permission to build and maintain bases on foreign territory include such things as economic support funding, arms purchasing agreements (Foreign Military Sales Financing Program), subsidized foreign military budgets (Military Assistance Program), Status-Of-Forces Agreements, Peace Keeping Operations, or International Military Education and Training Programs.

There are two trends associated with the costs of overseas basing; the first is that both fixed and permit costs have been rising. The second is that permit costs are becoming an increasingly larger percentage of the total overseas basing costs.

Figure 2 depicts these trends which are compiled from data in the Hudson Institute studies for the years 1974 through 1987 [Ref. 4]. In 1987, combined costs exceeded

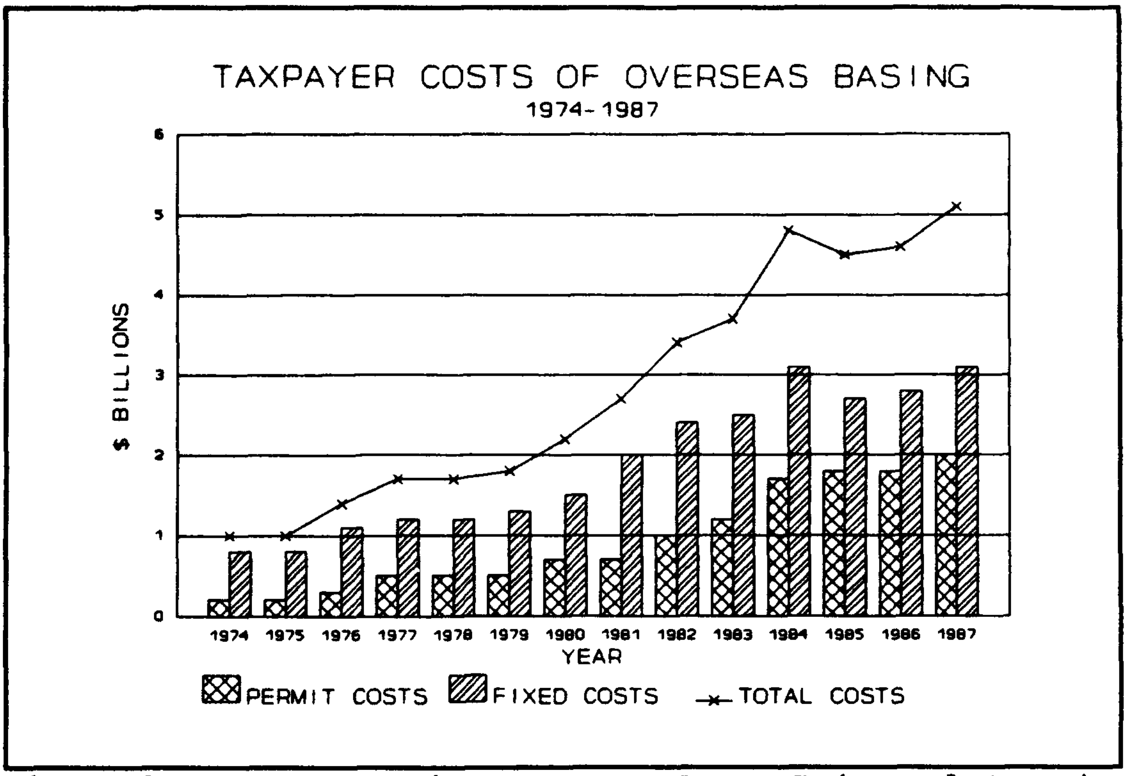

Figure 2 Overseas Basing Costs, 1974-1987 (Actual Costs)

five billion dollars. Projected costs for 1993 are as much as double that figure.

The Hudson Institute study projected costs through the year 2000 (in 1987 dollars). Although these studies were completed prior to the dissolution of the Soviet Union, the U.S. continues to maintain a policy of power projection and forward deployment as key components of its National Strategy. Thus the figures retain a substantial part of their validity.

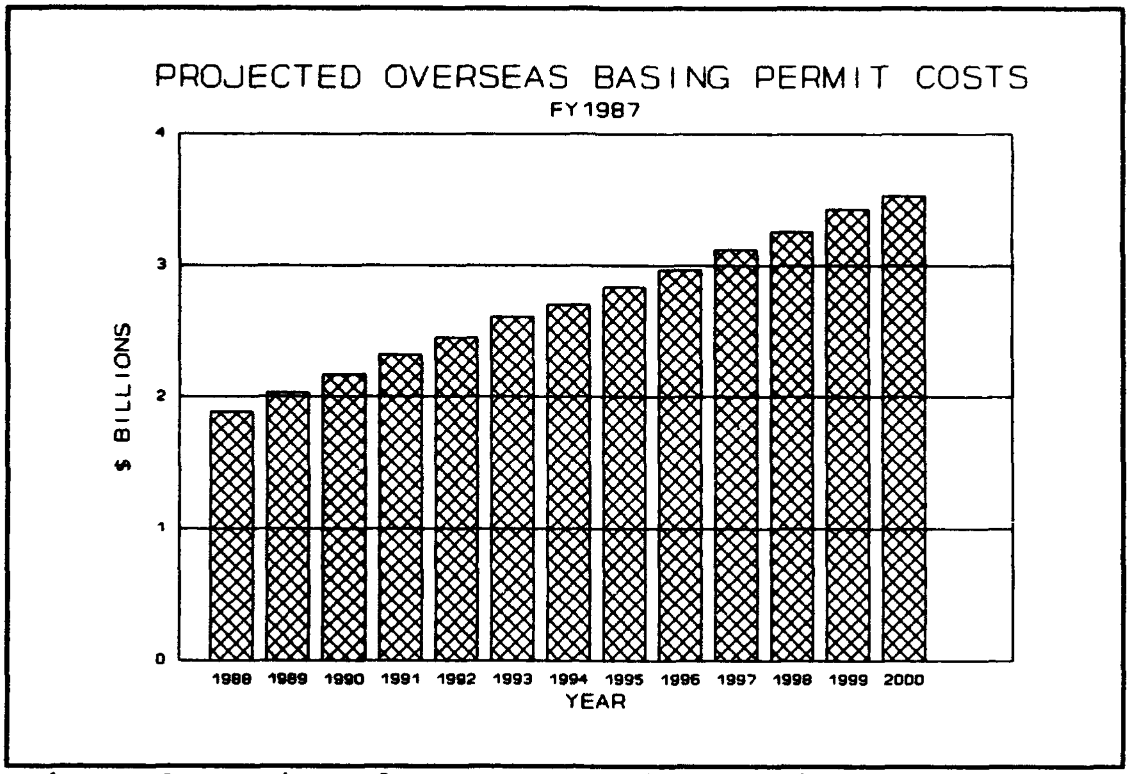

Figure 3 Projected Overseas Basing Permit Costs (FY 1987 dollars)

Projected permit costs (excluding the Philippines) are shown in Figure 3. The graph shows permit costs rising 150% by the year 2000.

The Hudson Institute projections for fixed costs associated with overseas bases includes costs related to the expansion of bases in Europe and South West Asia (SWA) anticipated at that time. Events subsequent to the study may have introduced a degree of error into these figures. However, they are believed to be fairly accurate and sufficient for illustrative purposes.

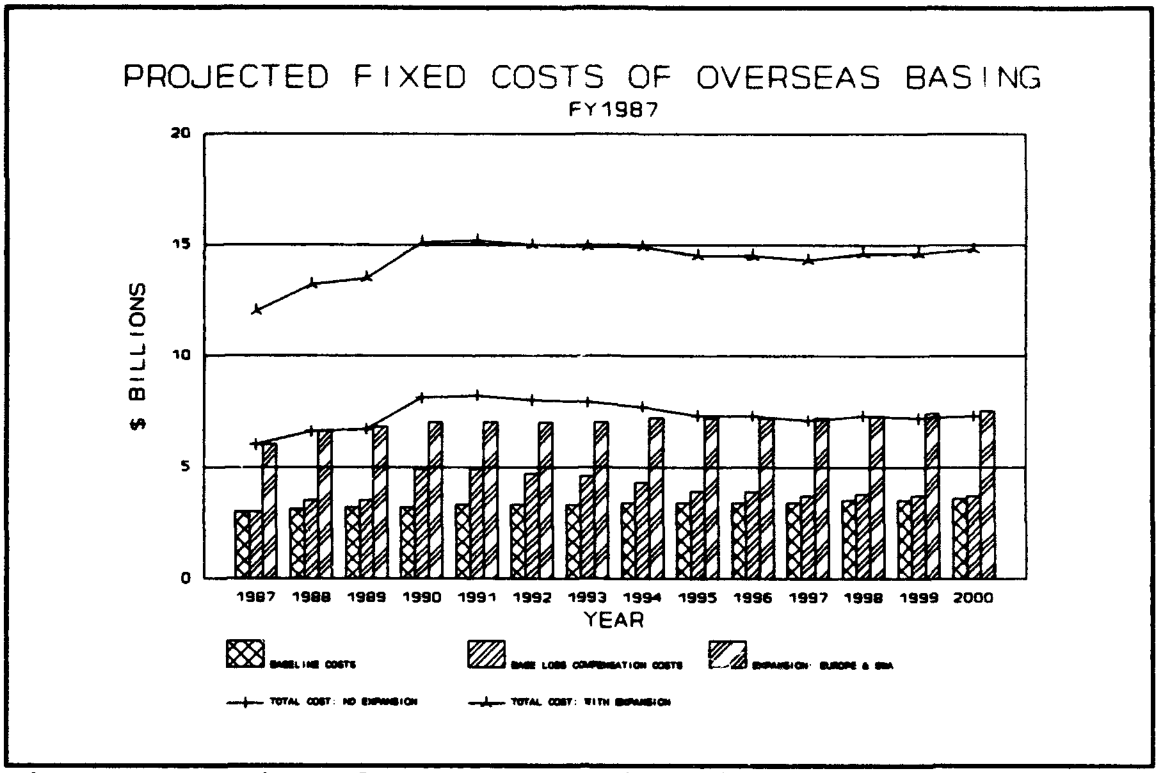

Figure 4 Projected Overseas Basing Fixed Costs (FY 1987 dollars)

Included in the fixed cost projections were costs associated with the start-up of facilities necessary to compensate for the anticipated closure of bases such as those in the Philippines. Events would reveal that this showed considerable insight. The closure of bases in the Philippines was accompanied by significant expansion of facilities on Guam and the opening of new facilities in Singapore.

Projected fixed costs are depicted in Figure 4, including baseline costs and those noted above. Total cost

Table I MOBS CONFIGURATIONS AND ASSOCIATED COSTS

DESIGN	NO. OF MODULES	ACQUISITION COST	O & M COSTS
MOBS: STOL	3	$0.735 B	$ 65 M
MOBS: MULTIMISSION	6	$1.325 B	$105 M

lines are shown both including and excluding expansion costs. Actual costs lie somewhere in-between.

By the year 2000, combined fixed and permit costs are expected to fall in the range of nine to twelve billion dollars. An independent NCEL report cites forecasts of overseas basing costs for 2000 on the order of 11 billion dollars, 7.5 billion dollars of which would be attributable to access costs [Ref. 5].

Table 1 shows the estimated acquisition and annual Operation & Maintenance costs for two variants of the Brown & Root, Inc. MOBS concept [Ref. 6]. Note that two multi-mission MOBS could be deployed for less than the cost of the access rights alone for many of the base sites.

2. Host Nation Support

Host nations, fully aware of the value the U.S. places on overseas bases, come to the access rights negotiating table with ever-increasing leverage. This leverage is applied not only to increase the level of compensation in the variety of forms noted above, but can be further used to enhance their influence on our national and international political and economic policies. As we have experienced in the past, host nations may preclude the use of territorial facilities or overflight rights for operations deemed not in their interests.

Other nations, perhaps dealing with internal dissension concerning U.S. presence on their territory (or, in the absence of a Soviet threat, simply finding it not in their interest to maintain a U.S. presence) are considering the option of eliminating U.S. bases.

MOBS offers an alternative to overseas bases whose costs exceed their utility or where excessive restrictions on use are imposed. The mere existence of MOBS would serve as leverage in our negotiations for existing base sites. MOBS can provide base facilities in regions where they are desirable but currently do not exist or could be placed as necessary to support unilateral operations potentially free of outside political influence.

Alternatively, MOBS might be perceived as an ideal platform for combined or United Nations-sanctioned

operations. As such, it could provide a stabilizing influence from international waters without infringing on regional territories.

Private sector applications, of which there are many, could proceed concurrently with military deployments when possible. The two latter options offer the additional incentive of sharing MOBS development, manufacturing, and deployment costs. MOBS affords the potential for enhanced operational latitude while posing interesting questions in a variety of areas.

E. THESIS GOALS AND OUTLINE

CDNSWC's feasibility study is comprehensive, addressing functional analysis, systems analysis and operational requirements, as well as technology and implementation issues. Wargaming is being employed as an assessment of MOBS interoperability with existing systems and viability in selected scenarios.

Not specifically addressed in the CDNSWC study is the MOBS deployment site selection process. That is, the establishment of a decision support model providing the actual Decision Maker (DM) with a structured, concise tool aimed at exploiting the capabilities of a high-value, scarce resource to the greatest extent possible.

Establishing a decision support model at this early stage of MOBS development provides:

1. An objective end-use perspective on MOBS.

2. A potential pilot model for use if a MOBS program is implemented.

3. A means of assessing the efficacy of pursuing MOBS development (through assessing model output).

The goal of this thesis is to establish such a model.

Chapter II addresses the decision model development. The objective and attribute hierarchy and measures of effectiveness are the subjects of Chapter III. Case studies and analysis follow in Chapter IV. Chapter V presents conclusions and recommendations.

II. MODEL DEVELOPMENT

A. PROBLEM STATEMENT

MOBS, as envisioned, would be a logistics platform comprising a semi-mobile node in the overseas basing network. As a logistics platform, there are two key factors in its employment: configuration and geographic location. Configuration determines inherent capabilities. Geographic location determines vulnerability to threats from hostile states. Both factors determine compatibility with other bases in the existing logistics network.

The integrity of the mutually supportive logistics network itself is highly dependent on Host Nation Support (HNS). The level of HNS may vary with the hostile state and the type of contingency planned.

Strictly quantifiable aspects of MOBS deployment, those of the time-distance equation and throughput capacity, are invariably affected by the uncertainty associated with the complex political interactions of allied and hostile nations in conflict.

B. DECISION MODEL CONTEXT AND OBJECTIVE

National Security Strategy, originating at the executive level, identifies threats and formulates U.S. posture regarding those threats. Political, economic, and military

strategies are developed and implemented, as appropriate, to mitigate or neutralize both ongoing and emergent threats.

The Chairman, Joint Chiefs of Staff (CJCS) translates National Military Strategy, as determined by the National Command Authority, into missions. These missions are assigned to the Commanders in Chief (CINCs) of operational commands who are allocated the resources necessary to accomplish those missions.

The focus of planning at all levels within the Department of Defense is the support of operational commanders, particularly the Unified Commanders. This is the central point of numerous official correspondence, including the *OPNAV Working Draft on Strategic Planning Guidance* and the landmark document *... From The Sea*. It is appropriate that the objective in making the MOBS deployment decision is <u>Effective Unified Commander Mission Support</u>.

The viewpoint of the CINCs provides a regional perspective ideal for evaluation of potential MOBS deployment sites as part of the overseas basing structure. The regional commands applicable to MOBS deployment are the Atlantic Command, Pacific Command, European Command, and Central Command. This derives from the fact that MOBS is a sea-based system. The Decision Maker (DM) is therefore assumed to exist within the hierarchies of the above commands.

It is further assumed that the information available to the DM includes the following:

- Missions assigned
- A prioritized list of states identified as posing a threat to National Security
- Resources and capabilities of allies and potential allies and a reasonable estimate of those of opposition forces
- Assessment of the regional political climate.

This information is critical to the development of probability distributions identified later in this chapter.

Due to its limited mobility, the MOBS deployment site selection would be based on *projected* situations and operations. As discussed in Chapter I, MOBS is a high-value/limited-availability resource. Its deployment must be part of the deliberate planning process to realize MOBS full potential.

C. MODELLING APPROACH

The DM, in this case assumed to be a staff member(s) of a command noted above, is confronted with the problem of selecting an "optimal" MOBS deployment site from a number of alternatives. Uncertainty regarding the availability of HNS and the degree of escalation/de-escalation of conflict (Conflict Level) within a region are underlying determinants

of deployment effectiveness. Also uncertain is the effect of the presence of MOBS itself on these factors.

This uncertainty represents the state of nature, the uncontrollable factors (from the DM perspective) surrounding the decision problem. These characteristics define a classic case for the methodology and practice of Decision Analysis.

Kirkwood states that,

> Decision analysis provides a practical, defensible approach to quantitatively analyzing decisions under uncertainty [Ref. 7] .

The components of decision analysis include influence diagrams, decision trees, subjective or statistical probability, and a measure of results (value or utility). The decision analysis methodology employed in this thesis will be as described in Marshall and Oliver [Ref. 8] and Chankong and Haimes [Ref. 9].

D. DECISION MODEL STRUCTURE

1. Symbology

Figure 5 displays the symbology, standard in the literature, used throughout the remainder of this thesis. The symbology is common to both influence diagrams and decision trees employed in the modeling process.

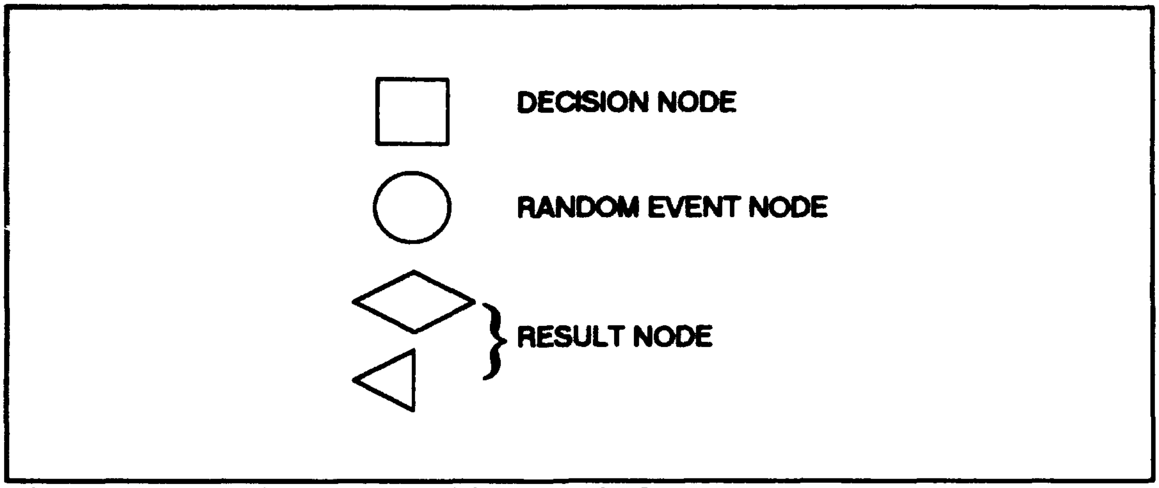

Figure 5 Decision Modeling Symbology

Square nodes represent decisions, each decision node having associated with it a *decision set*. Circular nodes are random event or chance nodes, each having associated with it a *random outcome set*. Diamond or triangular shapes represent result nodes. Result nodes are always end nodes.

2. Influence Diagrams

Influence diagrams facilitate the formulation, assessment, and evaluation of decision problems. They provide insight into probabilistic dependencies that exist between events. Directed arcs denote these conditional dependencies.

If a directed arc joins two nodes, it indicates that some form of dependence (influence or relevance) exists between these nodes. The generic situation, $X \rightarrow Y$, denotes that the outcome of event X is known at event Y and that X has some relevance or influence with respect to Y [Ref. 10].

3. Decision Trees

The decision tree evolves from, and is used in conjunction with, the influence diagram. Decision trees provide a visual representation of the sequence of decisions and random events that can occur in all possible scenarios of the decision problem. Branches are used to denote possible outcomes of random events or alternatives for a given decision in the described process.

From any given decision node there will be as many branches as there are possible decisions. From any given random event or chance node there will be as many branches as there are outcomes [Ref. 11].

E. MOBS DECISION MODEL

Decision-making models are intended to reduce real world complexities through a process of abstraction, including only important elements of the system modeled, to allow the DM to use the model to concentrate on the important aspects of the problem at hand. Too much complexity becomes unmanageable. Too much abstraction does not adequately reflect the true nature of the decision-making process.

The development of this decision model produced several generations of influence diagrams. Early variations resulted in thousands of possible decision tree end nodes. Through a combination of node synthesis, the elimination of relatively unimportant elements, and the employment of a

iterative design, the resulting model was reduced to four node sets and generally fewer than 50 result nodes.

The process is illustrated in Chapter IV. The following sections explain specific model elements.

1. MOBS Influence Diagram

a. *Decision Node*

The MOBS deployment decision node is actually the synthesis of two distinct decisions. The first asks whether or not MOBS should be deployed at all. The second asks that, given MOBS is deployed, what would the appropriate configuration be? The resulting decision set is:

$$D = \{d_1, d_2, \ldots, d_n\},$$

$$\textbf{\textit{where:}}\quad d_1 = \textit{NO MOBS option}$$
$$d_2, d_3, \ldots, d_n = \textit{individual MOBS configurations.}$$

This set includes each configuration and the no MOBS option. Note that this is a single-stage model and that specific configurations of MOBS modules must be predetermined. The model test case, discussed in Chapter IV, employs two Brown & Root, Inc., configurations. For that instance, the decision set consists of three elements,

$$D = \{\text{No MOBS, Config. 1, Config. 2}\}.$$

Due to the nature of the generic semi-submersible platform and modular concept, the potential exists for

numerous possible configurations. However, it is assumed that, due to the high costs involved, only a few general configurations (two to three) would be applicable in a given instance, and those configurations are primarily a factor of the aircraft they are required to support.

b. Random Events

As noted previously, several aspects of the prevailing regional political climate introduce uncertainty into the decision process. Uncertainty exists as to the level of conflict likely to evolve in a given set of circumstances. Uncertainty also exists in regard to the availability of HNS either from existing overseas bases or from emergent base sites made available by coalition forces in support of a given regional contingency.

(1) Conflict Level Chance Node

Execution of U.S. military strategy in a given region has one of the following consequences:

- Conflict deterred
- Status quo maintained
- Conflict escalates.

Some degree of forward presence is required to carry out strategy. Forward presence is therefore assumed to be a baseline in any MOBS deployment candidate location. This presence is normally maintained either by military forces

positioned in countries neighboring hostile states or by U.S. Naval forces in adjacent seas or both.

By designating presence as a lower bound on military involvement, a scale can be developed encompassing the possible consequences of a strategy in a given region:

Level 1. Forward Presence. As described above. Includes, for the purposes of this thesis, military involvement in drug interdiction operations and humanitarian relief.

Level 2. Low Intensity Conflict (LIC). A critical situation that can be settled (terminated or contained) with a small on-scene combat potential, with or without actual exchange of weapons fire. Peacekeeping operations would fall under this criteria.

Level 3. Lesser Regional Conflict (LRC). Combat power is employed. The scale is on the order of Grenada or Panama, but not necessarily of short duration. Peacemaking would fall under this criteria.

Level 4. Major Regional Conflict (MRC). Combat power is employed on a large, sustained, taxing level and employs Joint forces. Examples are Vietnam, the Korean War, and Desert Shield/Desert Storm.

Level 5. War. Assumed to be a major conflict involving Joint/Allied forces opposing a coalition of enemy forces [Ref. 12].

The resulting random event set is:

$$C^{CL} = \{\textit{Level } 1,\ \textit{Level } 2,\ \textit{Level } 3,\ \textit{Level } 4,\ \textit{Level } 5\},$$

where: ***the letter C denotes a chance node and the superscript CL denotes Conflict Level.***

(2) Host Nation Support Chance Node

The integrity of the overseas basing network is highly dependent on Host Nation Support (HNS). History has shown that a given host nation may restrict or preclude the use of its facilities for use in supporting contingencies deemed not in their best interest. HNS will depend on the political climate attendent to operations and the willingness of the Host Nation to permit use of facilities on its territory in support of that operation.

For example, HNS was invaluable in the success of Desert Shield/Desert Storm. Conversely, the absence of HNS greatly complicated U.S. air operations in Libya.

The disposition of critical host nation facilities would affect the value of MOBS. Therefore, the uncertainty associated with HNS is addressed by determining a distribution for the probability that a critical host nation will be available to support a contingency against a given hostile nation. The resulting random event set is binary:

$$C^{HNS} = \{\textbf{\textit{Host Nation Support, Absence of Host Nation Support}}\}.$$

c. Interpretation

Refer to the influence diagram in Figure 6 on the following page. The MOBS deployment decision is assumed to

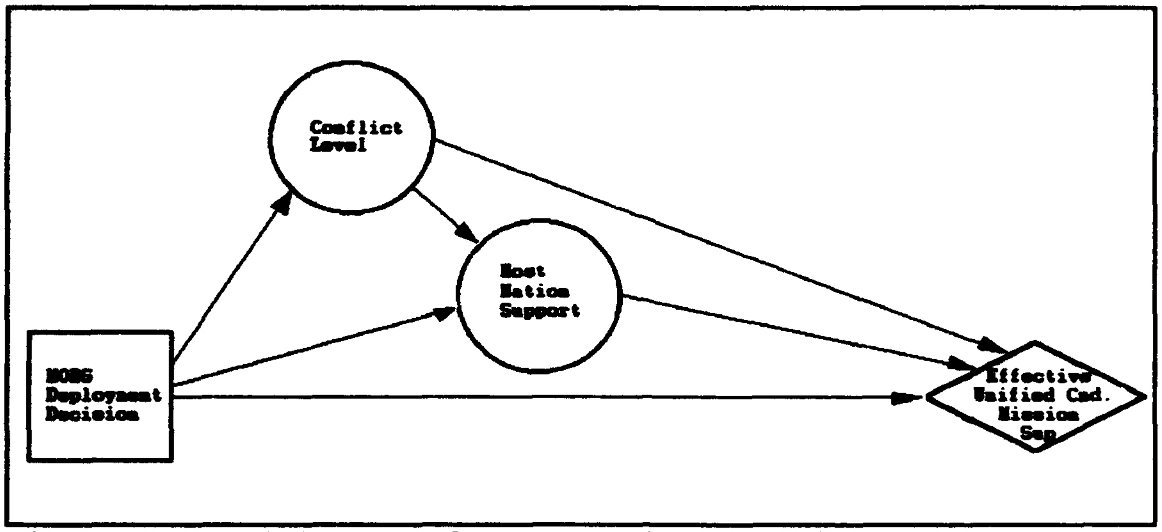

Figure 6 Conflict Level → HSN Influence Diagram.

influence the conflict level probability distribution, the HNS probability distribution, and the result (effectiveness of Unified Commander mission support).

In regard to the first chance node, the absence or presence of MOBS in each applicable configuration is presumed to affect the conflict level to some degree. This influence may manifest itself in either a decrease or increase in the probabilities associated with each conflict level, depending on whether its absence or presence deters or foments hostilities.

It is believed that MOBS would manifest a significant presence in a region - more so, perhaps, than surface ships (including aircraft carriers) whose presence are transitory in nature. How it will affect both ally and potential opponent is difficult to gauge.

It can be seen at the second chance node in Figure 6 that HNS is impacted by both the decision and the conflict level. This assumption is both intuitive and defensible.

It is reasonable to believe that the presence of a MOBS in a region will influence a Host Nation's willingness to permit access. MOBS could be perceived as representing a facility which diminishes the need for use of terrestrial-based U.S. forces on their soil or, alternatively, even as a threat to themselves (if the U.S. is acting unilaterally).

Historically, host nations have been willing to support a presence or peacekeeping forces (Levels 1 & 2) but balk at supporting increasing levels of operations. Conversely, as in the case of Saudi Arabia during Desert Shield/Storm, a prospective host nation may be unwilling to permit a foreign presence on their territory until their sovereignty is threatened at the MRC or higher conflict level. The conditional probabilities at the two respective chance nodes are:

$$\textbf{\textit{Chance Node 1,}}\ P\left\{ C^{CL} = c_j^{CL} \;\middle|\; D=d_i \right\},$$

$$\textbf{\textit{Chance Node 2,}}\ P\left\{ C^{HNS} \;\middle|\; D=d_i,\ C^{CL}=c_j^{CL} \right\}.$$

Lastly, all nodes are relevant to the effective mission support of the Unified Commander.

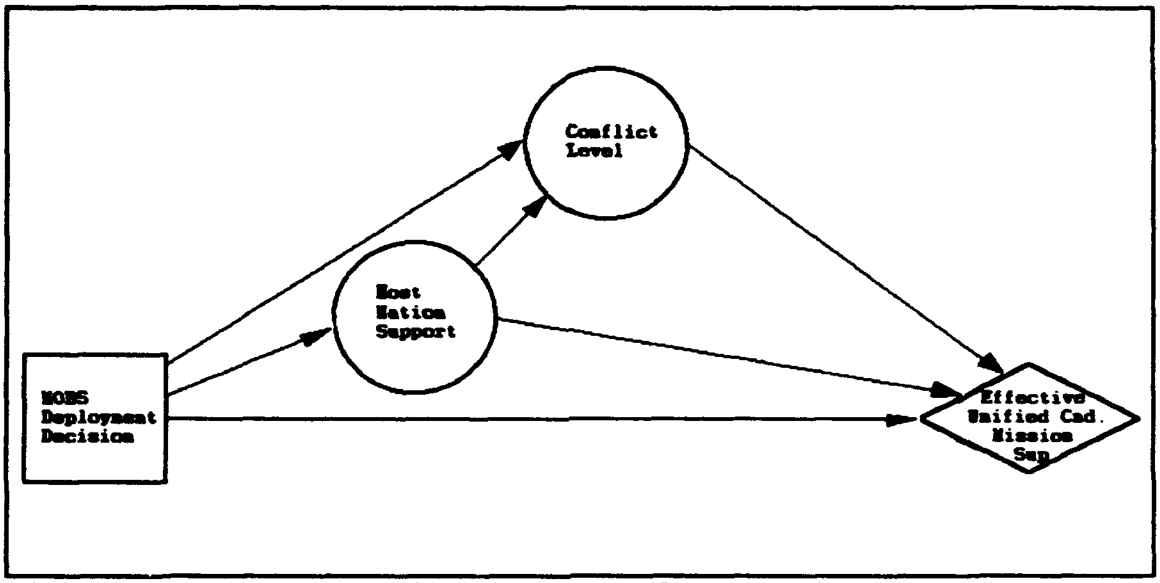

Figure 7 HSN → Conflict Level Influence Diagram

Now refer to Figure 7. Note that in this influence diagram the two random event node relative positions are reversed. This diagram reflects the point-of-view that the Conflict Level is conditional upon HNS. This approach is also defensible logically. A given host nation's decision to provide or withhold support might influence the Conflict Level probability distribution. However, the more intuitive reasoning supports the sequence in the original influence diagram. The example of Saudi Arabia previously cited is indicative. The influence diagram depicted in Figure 6 is the model used in the remainder of the thesis.

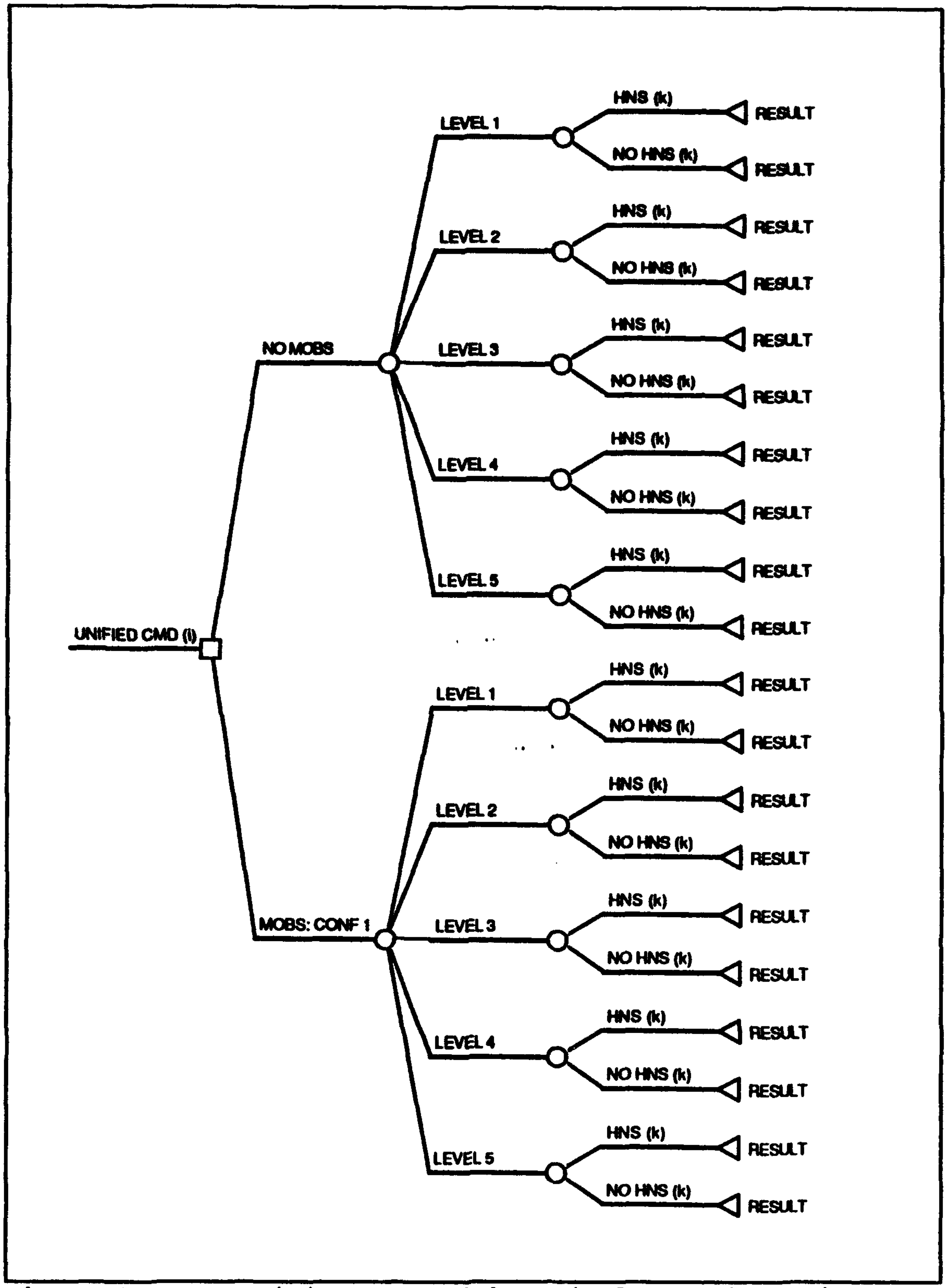

Figure 8 MOBS Decision Tree With a Single Configuration

2. Decision Tree

The decision tree derived from the influence diagram is depicted in Figure 8 on the following page. It reflects the evaluation of two MOBS configurations against the No MOBS case. The upper bound on the results for this particular combination of Unified Command, hostile state, and Host Nation (k) is 30. In the current international climate, escalation to a full war situation is unlikely; therefore, the probability of a conflict at Level 5 will be zero. This reduces the upper bound on result nodes to 24. Actual practice is likely to simplify the problem still further.

What remains to complete the model is the evaluation of the results. There are multiple approaches applicable to this model and several will be explored.

III. MEASURING RESULTS

A. OBJECTIVE AND ATTRIBUTE HIERARCHY

The model's overall objective is effective Unified Commander mission support. It remains to translate this objective into quantifiable and reproducible terms. Chankong and Haimes describe a hierarchical structure of objectives and attributes as a means to accomplish this translation. The overall objective is divided into lower level sub-objectives, each successive level becoming more specific and operational.

At the lowest level, objectives are sufficiently specific to be assigned *attributes*; defined as a measurable quantity whose value reflects the degree of achievement for a particular objective.

Chankong and Haimes state that:

> In order to assign an attribute or set of attributes to a given objective, two properties should be satisfied:
>
> 1. *Comprehensive*: its value is sufficiently indicative of the degree to which the objective is met.
>
> 2. *Measurable*: it is reasonably practical to assign a value on some scale to the attribute for a given alternative.

and,

> If the attribute has a natural unit that can be measured on the ratio scale, there is complete freedom in performing any mathematical operation on the value of such an attribute without destroying or distorting the information it contains [Ref. 13].

Figure 9 depicts the hierarchical structure developed for the MOBS deployment problem. Immediately apparent is the presence of multiple and, in some instances, conflicting attributes.

1. Costs

Costs used for the purpose of the model are as follows:

1. For existing overseas base sites, the combined annual fixed and permit costs as defined in Chapter 1, and estimated annual Operating and Maintenance (O&M) costs.

2. For emergent base sites, estimated permit costs (if applicable) plus start-up costs associated with base establishment (converted to annual costs over expected life of facility) plus O&M costs.

3. For MOBS, the estimated annual O&M costs plus the acquisition cost (distributed over 20 years).

Items one and two above are represented by the symbol C^B for a given iteration of the model. Similarly, the symbol for MOBS costs is C^M. The interaction of the costs in the model will be described in a later section.

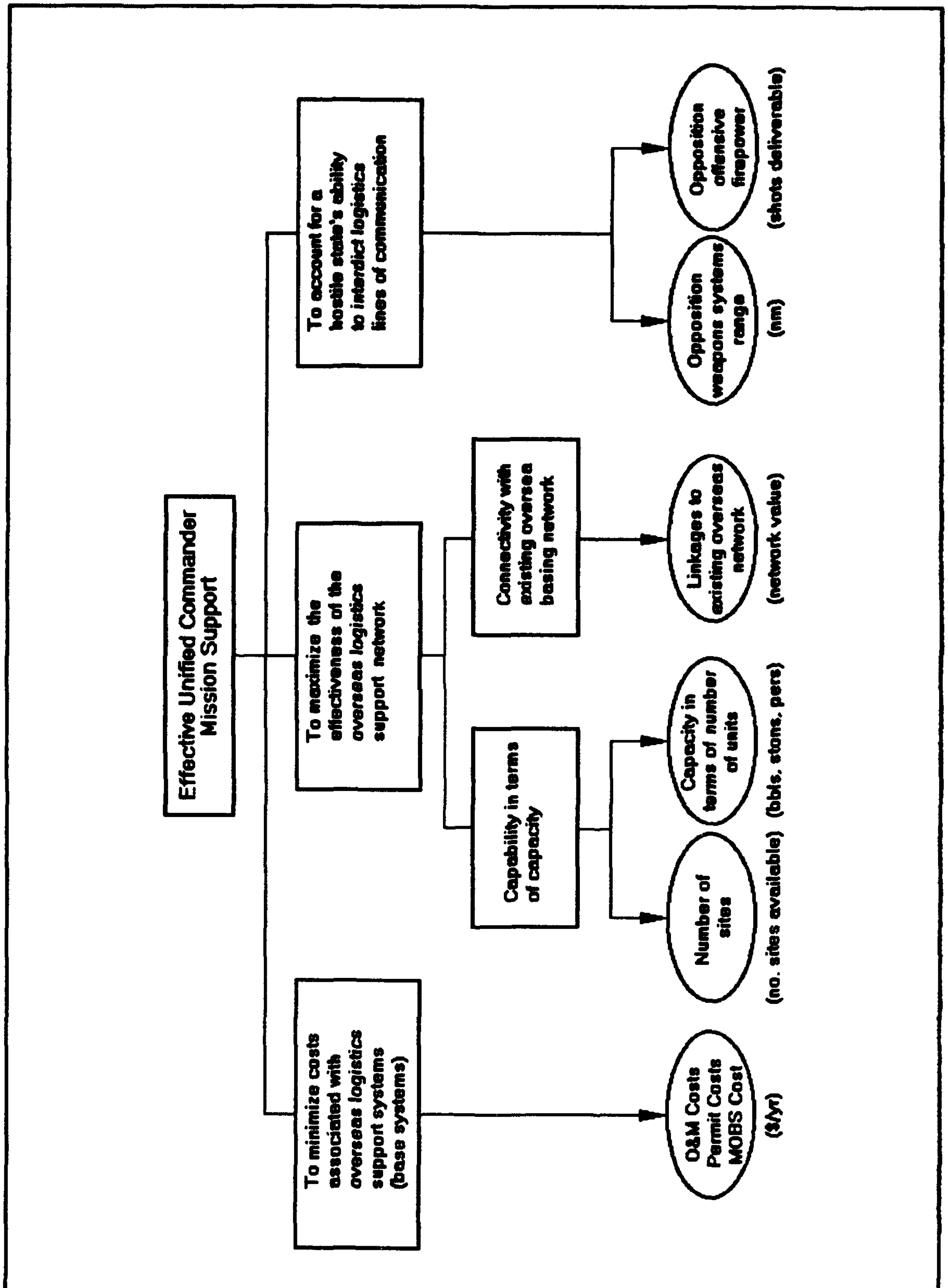

Figure 9 Objective and Attribute Hierarchical Structure

2. Effectiveness

Effectiveness is measured by the combined liquid and dry cargo storage capacities, personnel capacity, and "network value" of a facility. These attributes convey the concept of effectiveness in terms of capacity and flow for material and personnel.

A common unit of measurement is required for integration of these attributes in the model. The term employed is millions of cubic feet. *The Logistics Handbook for Strategic Mobility Planning* provides conversion factors for liquid and dry cargo capacities [Ref. 14]. These capacities are represented by the symbols $\mathbf{CF^{LC}}$ and $\mathbf{CF^{DC}}$, respectively.

Personnel capacity is normally conveyed as simply the number of personnel a facility can accommodate. It is common practice in facility design to plan for personnel accommodations in terms of square feet/person for a given environment or task. This practice is employed here for the purpose of standardizing units of measurement.

A somewhat arbitrary 108 cubic feet (3'x 6'x 6') is the estimated requirement/person for base facilities. This figure will be used as a standard for either land or MOBS bases. If a facility can accommodate 800 personnel, the equivalent is 86,400 cubic feet. The symbol for personnel

capacity is CF^p. In this manner, the differing measures of capacity can be combined into a common term.

The notion of network value as a means of assessing the contribution or effectiveness of overseas bases is described by Blaker et al. in the Hudson Institute U.S. Global Basing studies and is partially reproduced in Appendix A [Ref. 15]. Network value relates to the connectivity between bases, focusing on specific functions performed. A branch between two base sites can exist only if the base sites have common capabilities. The number of branches between a given base and other bases determines that bases' network value.

For the purposes of this thesis, a branch can exist if the bases are within the following distances from each other:

- Within the operating range of a C-130 aircraft for tactical airlift transactions: 1500 nm.
- Within the critical flight leg distance of C-141 aircraft for strategic airlift transactions: 2800 nm.
- Within 7 days sailing time of SL-7 container transport ships for sealift transactions: 3000 nm.
- Within the operating range of carrier-on-board delivery aircraft for naval force transactions: 1500 nm.
- Within 24 hours steaming time of a CVBG operating area: 500 nm.
- Within helicopter operating radius for both tactical and airlift transactions: 250 nm.

- **Within the combat radius of F-16 aircraft for tactical air transactions: 400 nm.**
- **Within 8 hours road march distance of an armored battalion for tactical ground operations: 150 sm.**

The network value of a base site is designated by the symbol N.

To accommodate the integration of the network factor into the equation for the overall efficiency, it is modified by multiplying it by a ft^3/N tradeoff weight represented by the symbol *w*. This trade-off weight will be addressed in detail in Section B below. The applicable equations for equivalent cubic feet for a host nation and MOBS are as follows:

$$ECF^{H} = \sum_{i=1}^{n}\left(CF_i^{LC} + CF_i^{DC} + CF_i^{P}\right) + w\sum_{i=1}^{n} N_i$$

$$ECF^{M} = \left(C_M^{LC} + C_M^{DC} + C_M^{P}\right) + w\,N_M$$

where:

CF^{LC}	is the cubic feet (millions) of liquid cargo
CF^{DC}	is the cubic feet (millions) of dry cargo
CF^{P}	is the cubic feet (millions) equivalent of personnel capacity
N	is the network value
w	is network value-to-cubic feet trade-off weight.

The subscript *i* in the above equation accounts for the fact that each host nation may provide more than one base site.

Capacities are aggregated to represent the host nation as a single node. Similarly, multiple host nations are accommodated simply by combining $\mathbf{ECF^H}$ values for each one to form, in effect, the regional host network as a single entity.

3. Hostile State Offensive Capability

The offensive capability of a hostile state is presumed to impede the efficiency of base sites, conceivably at any of the established conflict levels. This is quite obvious at the LRC level or above, but may be evident at lower conflict levels as well. For example, there may exist the potential for sabotage or terrorist actions requiring heightened levels of security at Conflict Levels 1 and 2. Increasing security generally impedes the flow of personnel and material.

This element is introduced to the model as a percentage of the raw combined cubic feet capacity. It is represented by the symbols $\mathbf{T^M}$ and $\mathbf{T^H}$ as applied to MOBS and a given host nation, respectively. The equations are:

$$EFF_j^H = T_j^H \; (ECF^H)$$

$$EFF_j^M = T_j^M \; (ECF^M)$$

where: j = (1, 2, 3, 4, 5) for a given conflict level
$\mathbf{T_j^H}$ and $\mathbf{T_j^M}$ are on (0,1)
$\mathbf{EFF_j^H}$ and $\mathbf{EFF_j^M}$ are the resulting effectiveness at each conflict level.

A reproducible means of quantifying the value of **T** is derived from the discussion of striking power in Capt. W.P. Hughes, Jr., USN (Ret.) book *Fleet Tactics* and the text of a presentation he made on "The Value of Warship Attributes" [Ref. 16]. In the latter, Capt. Hughes derives the "pulsed power" equation for modern missile warfare from the Fiske salvo model (derivation provided in Appendix B). The pulsed power equation is:

$$\Delta A = \frac{\sigma_B b_2 B - \tau_A a_3 A}{a_1}$$

where:

ΔA	is the number of ships out of action per salvo
a_1	is staying power in terms of number of hits each ship can absorb before being OOA
a_3	is the number of incoming shots (SSMs) each defending unit can neutralize
A & B	are the number of ships for Blue and Red forces respectively
b_2	is the striking power (no. of shots) per enemy ship
σ_B	is enemy scouting effectiveness: $0 < \sigma < 1$
τ_A	is defensive readiness: $0 < \tau < 1$.

If enemy scouting is ineffective, σ_B equals zero. Similarly, if friendly defenses are not prepared, τ equals zero.

The pulsed power equation is intended as a force-on-force campaign analysis tool. Its use here is generalized to provide a means to assess the degradation of

effectiveness that might reasonably be expected in the face of a determined and effective adversary.

This concept is applied to the determination of **T** in the following manner:

$$\mathbf{T} = 1 - \Delta A$$

For the purposes of this model, the pulsed power equation is interpreted as follows:

- $\mathbf{a_1}$ is the estimated number of shots MOBS or host nation base sites as a whole can absorb before they are OOA.
- **A** is equal to the number of base sites for a given host nation or is equal to one in the case of MOBS.
- $\mathbf{a_3}$ is as described above and will depend on known or projected logistics base defensive capabilities.
- τ_A is assumed to be one.
- σ_B will depend on the hostile state in the evaluation.
- **B** is the number of surface, subsurface, or air units the hostile state might be expected to commit to destroying a given logistics base sites in a given conflict level.
- $\mathbf{b_2}$ is the number of shots (SSMs, ASMs, etc.) per enemy unit.

A numerical example is provided using information from the case study in Chapter IV. Assume a hostile state possesses a reasonably effective military and fair scouting assets and the conflict is at the MRC level. It is estimated that, over time, the hostile state would deploy four guided missile patrol boats (PGM) and ten attack

aircraft against a MOBS deployed 250 nm off their coast. Among them, the PGMs carry four 50 nm missiles and each aircraft carries two 30 nm missiles. The total number of shots deliverable is 36.

Assume that MOBS is under the protective umbrella of at least two carrier battle groups (CVBG) tasked with performing multiple missions along with air and surface cover for the MOBS. MOBS is assumed to possess a point defense system. The respective variables and the pulsed power equation might look like:

A = 8 (4 CAP, 2 Helos, 2 surface units)
B = 14 (4 PGMs, 10 A/C)
a_1 = 12
a_3 = 1.2 (ave.)
b_2 = as described above
σ_B = 0.45
τ_A = 1.00

$$\Delta A = \frac{[\sigma_B(b_2^1 B^1 + b_2^2 B^2)] - [\tau_A a_3 A]}{a_1}$$

$$= \frac{[\ 0.45\ (4(4) + 10(2))\ ] - [1\ (1.2)(8)\ ]}{12} = 0.55$$

and:

$$T_4^W = 1 - 0.55 = 0.45.$$

Selecting the MRC or Conflict Level 4 for this example was deliberate. Determining **T** for each host nation basing network and for each MOBS under consideration at all

conflict levels is unnecessarily complex for the detail required in this model. It is suggested, therefore, that **T** be determined for each of these at the MRC level only and that it be scaled up or down for other levels accordingly.

4. The Unifying Equation

Combining cost and effectiveness into one equation produces a decision tree with a single attribute. This results in significant simplification of the problem and analysis. The equation is a straight-forward determination of equivalent cost:

$$\boldsymbol{EQUIVCOST} = (\boldsymbol{C^{H}} + \boldsymbol{C^{M}}) + \boldsymbol{V}(\boldsymbol{EFF^{H}} + \boldsymbol{EFF^{M}})$$

where: **V** is in terms of COST/EFFECTIVENESS and represents a trade-off weight.

Note the occurrence here of a second trade-off weight. This and the trade-off weight **w** described in subsection two will be discussed in the following section.

B. TRADE-OFF WEIGHTS

It is useful at this point to recall that a goal of the decision analysis is to determine the "best" alternative among a given set of acts. In accordance with Bernoulli's principle,

> If an individual is confronted with a decision problem in which a choice is to be made from a given set of acts (risky prospects), knowing full well that the outcome of

a given act depends on the occurrence of a future state of nature whose probability (of occurrence) is known or can be estimated, the individual should then choose an act which will yield the highest expectation in terms of the preference over the possible consequences [Ref. 17].

Introducing the equivalent cost equation developed in the previous section to the decision tree, and employment of the rollback algorithm (described in most decision analysis texts), will identify a preferred or *noninferior* solution. However, if plausible variations in the values of variables would change the preferred alternative, further analysis must be conducted.

Ultimately, the goal is not to give the decision maker a single solution or point estimate. Rather, it is to clarify the interaction of variables so that the DM can better understand the trade-offs inherent in their decision. Trade-off weights are a means to provide this insight to the DM and to aid in the resolution of conflicts.

1. Capacity - Network Value Trade-off (w)

The variable **w** does more than facilitate the integration of units, it shows the relative value of capacity vs. flow, which can be useful information for the DM. For a given set of variables, plotting a graphical solution of **w** against expected value will depict ranges of **w** for which differing decision alternatives may be preferred.

2. Cost - Effectiveness Trade-off (V)

Here again, a graphical solution will convey to the DM the range for which varying levels of added equivalent cost will indicate one decision alternative over another.

By combining an analysis of **w** and **V** with sensitivity analysis applied to other variables within the model, a complete and accurate picture of the decision space and possible excursions can be provided to the DM who can then, in turn, make an informed decision.

IV. CASE STUDY AND ANALYSIS

A. DECISION MODEL PROCESS FLOW

Employment of the MOBS decision model requires the determination and tracking of multiple variables and parameters. The flow chart in Figure 10 delineates recommended steps to facilitate this process. The case studies in following sections utilize this flowchart.

B. CASE STUDY BACKGROUND

Three case studies are presented. Each study represents one of three potentially hostile states within one of the previously identified Unified Command geographical regions. The primary variant in each study is the Conflict Level probability distribution. The three distributions, depicted in Figure 11, have been chosen to represent relatively extreme circumstances in order to exercise the model. Parameters used in actual practice are likely to vary.

Two tools will be employed concurrently to implement the decision model. The first is a spreadsheet model utilizing Quatro Pro. The second is Decision Analysis by Tree Age (DATA), which is commercial decision analysis software. This is done to corroborate results and to illustrate that the model can be implemented utilizing a variety of software.

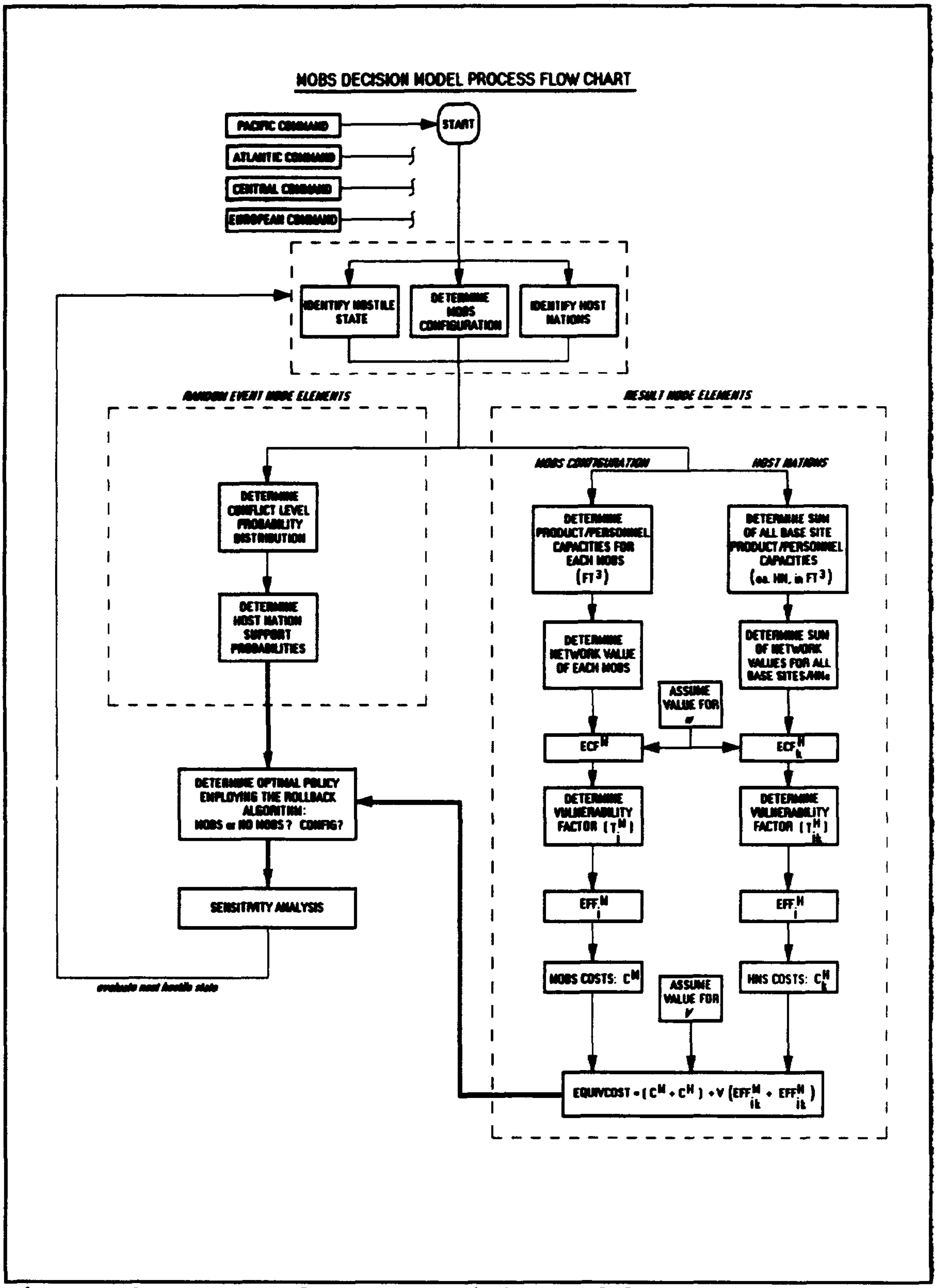

Figure 10 MOBS Deployment Decision Model Process Flow Chart

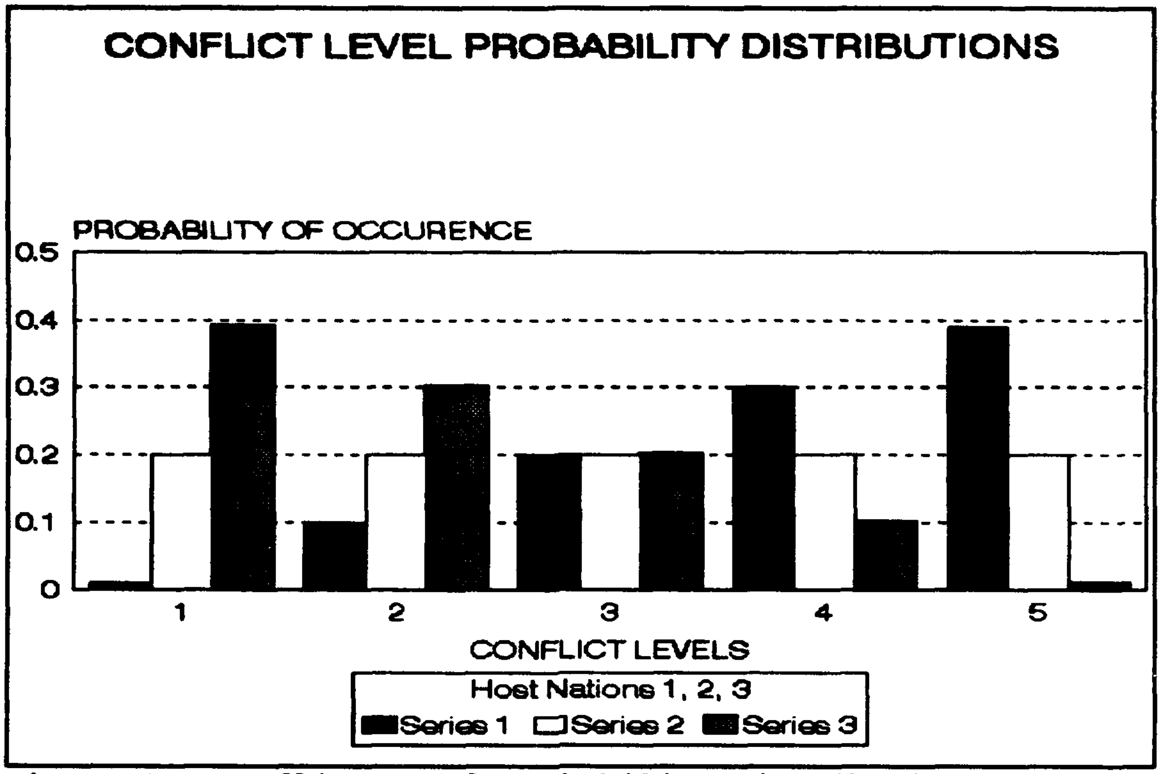

Figure 11 Conflict Level Probability Distributions

The region of concern for the decision model is assumed to have three host nations whose support would be critical to planned contingencies against each of the hostile states. Each host nation represents distinctly different circumstances:

> Host Nation 1. A nation whose regime is wholly supportive of the U.S. Access and use are unrestricted in all circumstances (the probability of HNS = 1). No permit costs are charged for U.S. presence. Limited resources are available.

Table II MOBS DATA

CONFIGURATION	NO. MODULES	COSTS (millions)		CARGO CAPACITY (mils ft^3)		
		ACQ.	O&M	LIQ	DRY	PER
STOL	3	$ 735	$ 65	2.28	3.580	0.09
MULTIMISSION	6	$1325	$105	4.56	6.10	0.17

Host Nation 2. This nation provides substantial resources and a number of base sites; however, support is tentative and access and use may be restricted. Permit and other costs are high.

Host Nation 3. Defined as an "emergent" host nation. No peacetime access or use permitted. However, this nation shares a border and has suspended formal relations with the hostile state. Support is expected to be provided in the event hostilities escalate and the nation's sovereignty is threatened. Several base sites would be available. Permit costs would be zero but there would be costs associated with establishing facilities and O&M. The proximity to the hostile state puts facilities within this nation at some risk.

Two MOBS configurations, derived from Brown & Root, Inc. concepts, will be under consideration for introduction into the region. These are identified as MOBS Configuration 1 (STOL) and MOBS Configuration 2 (Multimission). Costs, configuration, and capacities are delineated in Table II.

Table III HOST NATION CARGO CAPACITIES AND NETWORK VALUES

HOST NATION	EQUIVALENT CUBIC FEET (mil)				NETWORK VALUE
	LIQUID CARGO	DRY CARGO	PERS.	TOTAL	
1	8.00	6.00	0.22	14.22	12
2	50.00	200.00	2.16	252.16	43
3	28.00	42.00	1.10	71.10	30

The case studies involve the evaluation of combinations of host nations with and without MOBS for each Conflict Level distribution. For the purpose of illustration, sample calculations for the first case study are described in detail. Results of the remaining evaluations are presented in tabular form with the associated spreadsheet and DATA print-outs available for inspection in Appendix C. Data for Host Nations are shown in Table III.

C. CASE STUDY

The initial case study evaluates the potential for introduction of MOBS into the region in support of contingencies opposing Hostile State 1. The combined resources of the three host nations previously described are be evaluated against those same resources combined with each of the two MOBS configurations.

Table IV PROBABILITY OF HOST NATION SUPPORT BY HOST NATION AND MOBS CONFIGURATION

HOST NATION	MOBS CONFIG.	CONFLICT LEVEL				
		1	2	3	4	5
1	NO MOBS	1.0	1.0	1.0	1.0	1.0
	MOBS 1	1.0	1.0	1.0	1.0	1.0
	MOBS 2	1.0	1.0	1.0	1.0	1.0
2	NO MOBS	1	0.8	0.5	0.4	0.2
	MOBS 1	1	0.9	0.6	0.5	0.3
	MOBS 2	1	0.9	0.6	0.5	0.3
3	NO MOBS	0.0	0.1	0.6	1.0	1.0
	MOBS 1	0.0	0.2	0.7	1.0	1.0
	MOBS 2	0.0	0.2	0.7	1.0	1.0

1. Random Event Node Elements

The Conflict Level probability distribution for Hostile State 1, derived from intelligence and state department estimates, is as shown in Figure 11. Note that there is a high probability that hostilities will escalate.

The respective probabilities of HNS at each Conflict Level are described in Table IV. Note that for Host Nations 2 and 3, the probability that those nations will provide support increases with MOBS present. Recall that, in the

influence diagram for the model, the decision node was assumed to influence the HNS chance node.

For the remainder of the thesis, that influence is assumed to be that the presence of MOBS, regardless of configuration, will increase the likelihood that HNS will be provided.

If MOBS is being evaluated against a single host nation, the probabilities of HNS above can be used directly in the model. However, if several host nations are being evaluated as a unit, the individual HNS probabilities must be aggregated for use in the model.

Since the probability of HNS is the probability that that nation's equivalent cubic feet are available for use, probabilities will be weighted in proportion the individual nation's contribution to the regional network as a whole.

For instance, from Table III, Host Nation 2 has **252.16** million cubic feet of capacity and a network value of **43**. The input value for **w** is **10**. Host Nation 2's equivalent cubic feet capacity is:

$$\begin{aligned} ECF_2^H &= \left(CF_2^{LC} + CF_2^{DC} + CF_2^{P} \right) + w N_2 \\ &= (50.00 + 200.00 + 2.16) + 10(43) \\ &= 682.16. \end{aligned}$$

As is shown below, the combined equivalent cubic feet capacity of the three host nations is **1187.48**. The

probability of HNS for Host Nation 2 with MOBS 2 and at Conflict Level 3 (from the table above) is **0.60**.

Therefore, the weighted contribution of Host Nation 2 to the aggregate HNS for the conditions described is:

$$0.6\left(\frac{682.16}{1187.48}\right) = 0.34.$$

This value is combined with that of Host Nations 1 & 3 for the aggregate probability of HNS at Conflict Level 3 with a MOBS 2 configuration.

Note that the calculation of the equivalent cubic feet for the weighted HNS probability necessarily involves the inclusion of the variable **w**. While it is true that varying **w** will cause some variation in the weighted probabilities, the same value for **w** will be used for all calculations; furthermore, it can be shown that this variation is relatively small and not of significant consequence in this application.

2. Result Node Elements

The data for host nation capacities and network values are shown in Table III. With this information, combined with the MOBS data from Table II, the values for $\mathbf{ECF^M}$ and $\mathbf{ECF^H_k}$ can be determined:

For MOBS 1:

$$ECF^{M1} = \left(C_M^{LC} + C_M^{DC} + C_M^{P} \right) + w\,N_M$$
$$= \left(2.27 + 3.58 + 0.09 \right) + 10(7) = 75.94.$$

For MOBS 2:

$$ECF^{M2} = \left(C_M^{LC} + C_M^{DC} + C_M^{P} \right) + w\,N_M$$
$$= \left(4.56 + 6.10 + 0.17 \right) + 10(12) = 130.83.$$

For Host Nation No. 1:

$$ECF_1^H = \sum_{i=1}^{n}\left(CF_i^{LC} + CF_i^{DC} + CF_i^{P} \right) + w\sum_{i=1}^{n} N_i$$
$$= \Big[\left(1.20+0.90+0.06\right) + \left(2.80+1.40+0.06\right) + \left(4.00+3.70+0.09\right) \Big] + 10\left(2+3+7\right)$$
$$= 134.21.$$

Similarly, for Host Nations 2 & 3:

$$ECF_2^H = 252.16 + 10(43) = 682.16,$$
$$ECF_3^H = 71.10 + 10(30) = 371.10.$$

The value for T_4^M was calculated in the previous chapter as 0.45. This value, and those for each combination of hostile state and host nation/MOBS configuration, are shown in Table V.

Table V VULNERABILITY FACTORS

VALUES FOR TAU					
CONFLICT LEVEL	**HOSTILE STATE NO.1**				
	HN 1	**HN 2**	**HN 3**	**MOBS 1**	**MOBS 2**
1	1.00	1.00	1.00	1.0	1.0
2	1.00	0.95	0.90	1.0	1.0
3	1.00	0.80	0.70	0.60	0.80
4	1.00	0.65	0.50	0.45	0.60
5	1.00	0.45	0.35	0.25	0.40
	HOSTILE STATE NO. 2				
1	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	1.00	1.00	1.00
3	1.00	0.92	0.90	0.95	0.98
4	1.00	0.86	0.83	0.87	0.92
5	1.00	0.80	0.75	0.82	0.89
	HOSTILE STATE NO. 3				
1	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	1.00	1.00	1.00
3	1.00	0.92	0.93	1.00	1.00
4	1.00	0.86	0.88	0.95	0.99
5	1.00	0.80	0.83	0.91	0.95

The Equivalent Cubic Feet value for each instance of host nation and MOBS configuration, is multiplied by the vulnerability factor **T** for each, as it has been determined

at every Conflict Level. The individual results for host nations are aggregated to comprise the value for $\mathbf{EFF}_j^H$ and $\mathbf{EEF}_j^M$ as determined for each MOBS. Test Case 1 examples are:

For combined host nations:

$$
\begin{aligned}
\mathbf{EFF}_4^H &= \sum_{k=1}^{3} \mathrm{T}_{4k}^H \left(\mathbf{ECF}_k^H \right) \\
&= (1.00 * 134.22) + \\
&\quad\; (0.65 * 682.16) + \\
&\quad\; (0.50 * 71.10) \\
&= 763.17.
\end{aligned}
$$

For MOBS 1:

$$
\begin{aligned}
\mathbf{EFF}_4^{M1} &= \mathrm{T}_4^M \left(\mathbf{ECF}^{M1} \right) \\
&= 0.45 * 75.95 \\
&= 34.18.
\end{aligned}
$$

For MOBS 2:

$$
\begin{aligned}
\mathbf{EFF}_4^{M1} &= \mathrm{T}_4^M \left(\mathbf{ECF}^{M1} \right) \\
&= 0.60 * 130.83 \\
&= 78.50.
\end{aligned}
$$

Finally, the product of the tradeoff variable **V** and the above effectiveness values are added to the combined host nation and MOBS configuration costs as applicable to produce the value introduced at the decision tree result nodes.

The following are the values for Conflict Level 4 at each of the three decision branches:

$$\begin{aligned} \boldsymbol{EQUIVCOST_{R7}} &= \sum_{k=1}^{3} C_k^H - V\left(EFF_{4k}^H\right) \\ &= \left(225 + 865 + 350\right) - 1\left(763.17\right) \\ &= 676.83, \end{aligned}$$

$$\begin{aligned} \boldsymbol{EQUIVCOST_{R17}} &= \left(C^{M1} + \sum_{k=1}^{3} C_k^H\right) - \left(V\left(EEF^{M1} + EFF_{4k}^H\right)\right) \\ &= \left(101.75 + 225 + 865 + 350\right) - 1\left(34.18 + 763.17\right) \\ &= 744.40, \end{aligned}$$

$$\begin{aligned} \boldsymbol{EQUIVCOST_{R27}} &= \left(C^{M2} + \sum_{k=1}^{3} C_k^H\right) - \left(V\left(EEF^{M2} + EFF_{4k}^H\right)\right) \\ &= \left(171.25 + 225 + 865 + 350\right) - 1\left(78.50 + 763.17\right) \\ &= 769.58. \end{aligned}$$

These values can be found at result nodes 7, 17, and 27 in the spreadsheet and DATA decision trees displayed on the following pages (Figures 12 & 15). All other result node values are obtained in the same fashion and introduced into the decision tree.

3. Case Study Results

Given **w** = 10 and **V** = 1, the preferred policy is the "No MOBS" option. Sensitivity analysis was conducted on the trade-off variables **w** and **V** using a function built into the

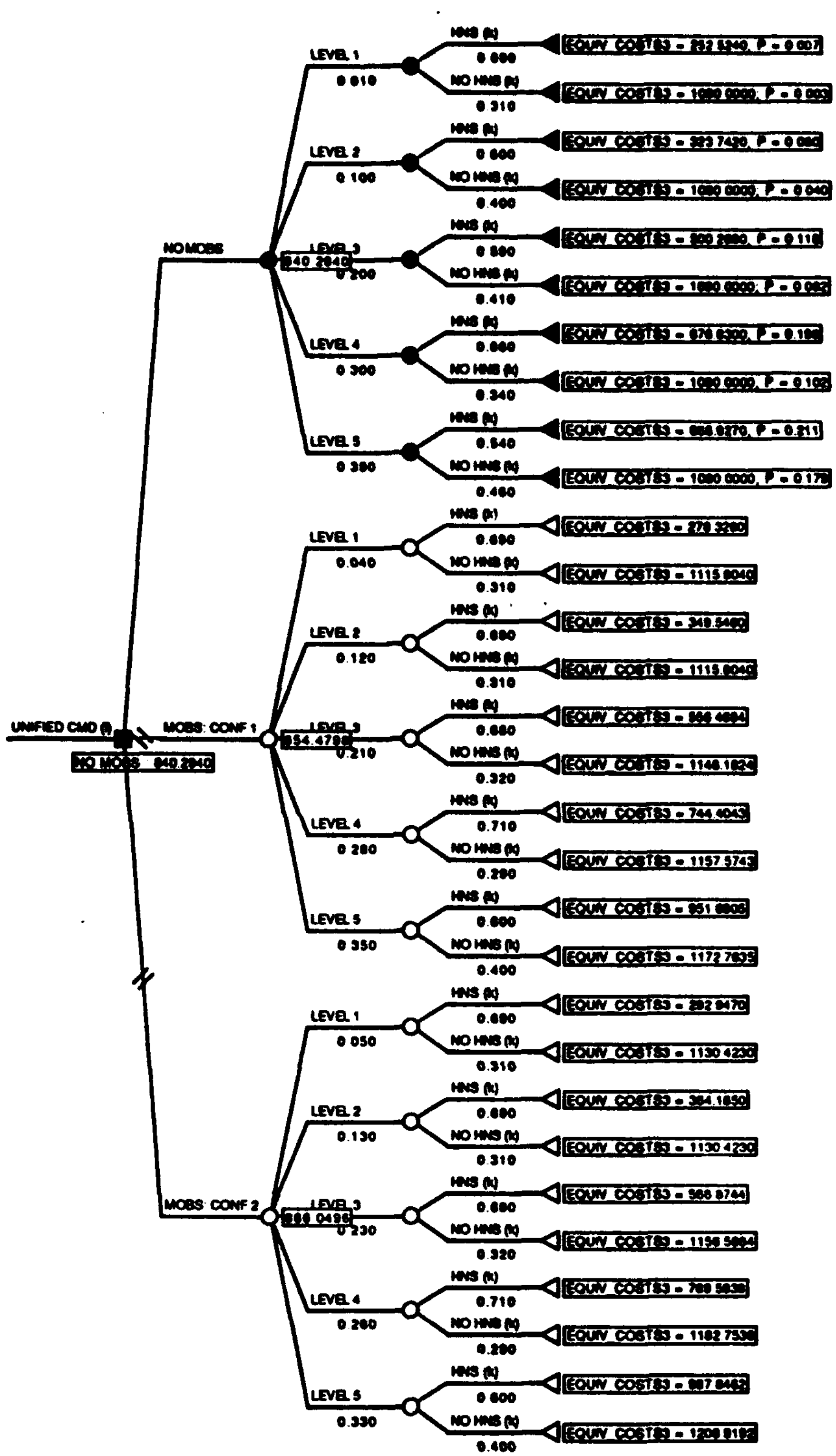

Figure 12 DATA Decision Tree After Rollback

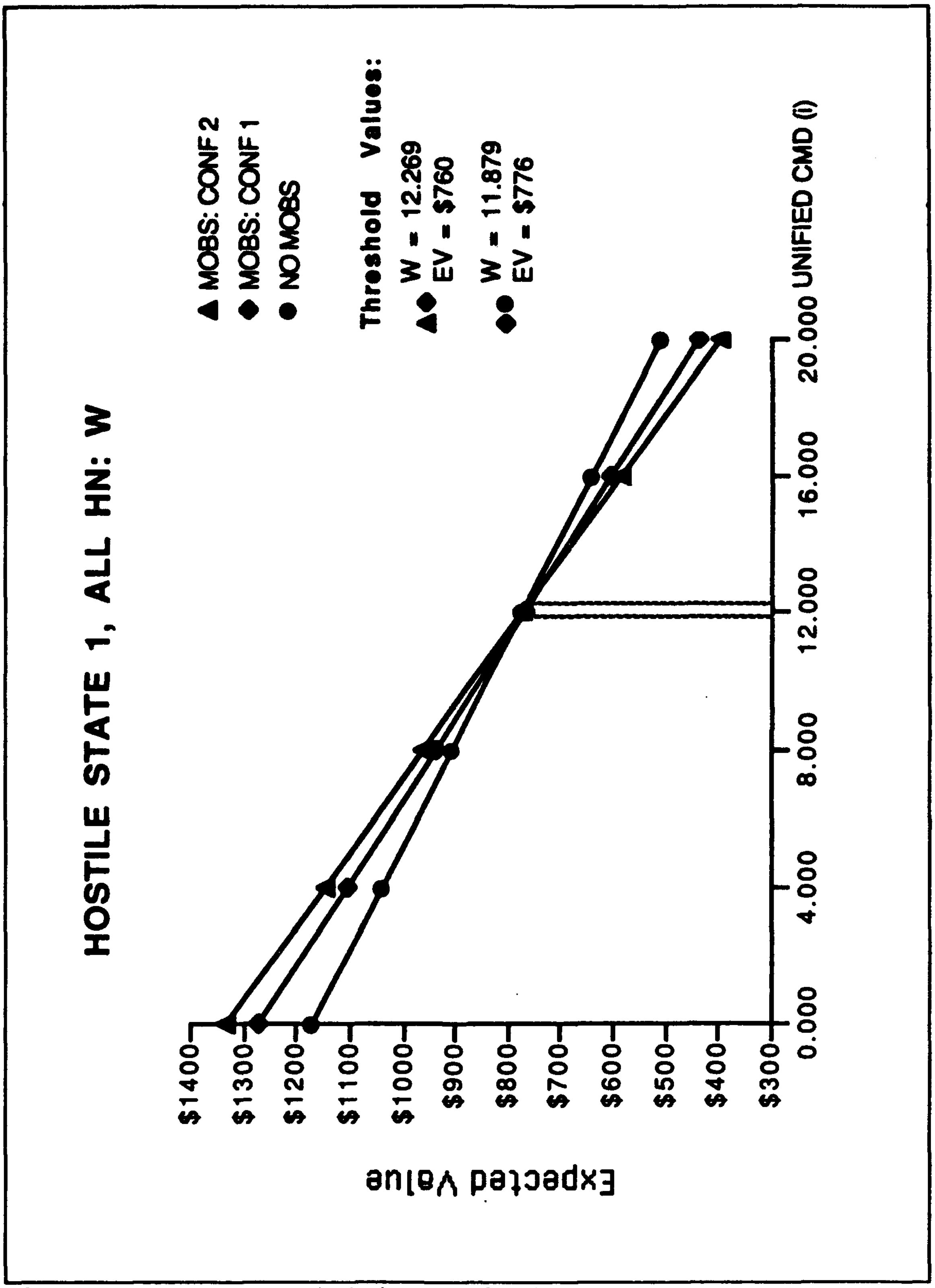

Figure 13 DATA Sensitivity Analysis on **w**

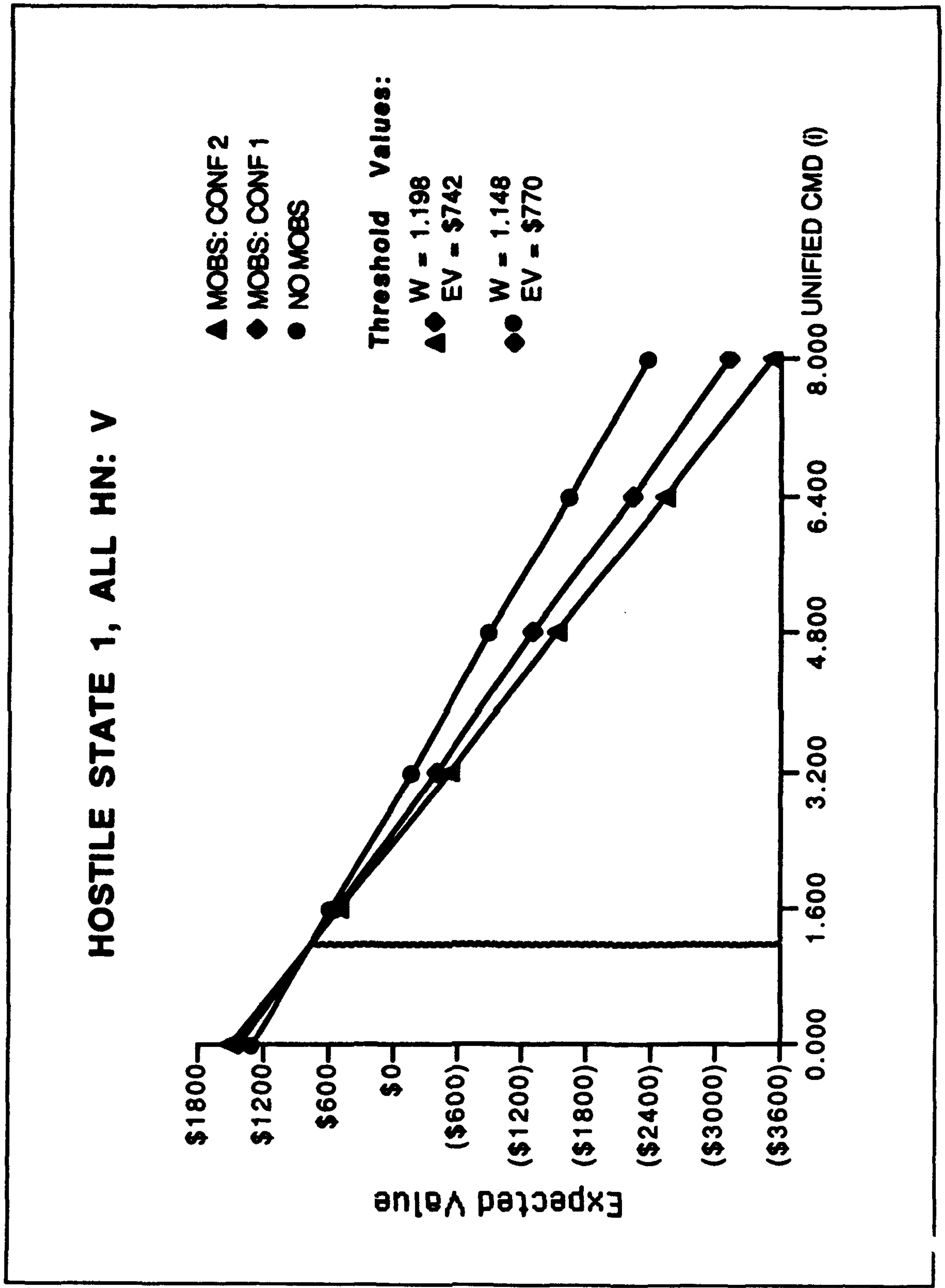

Figure 14 DATA Sensitivity Analysis on V

HOSTILE STATE NO. 1	COMBINED HOST NATION SUPPORT

ANNUAL COSTS CHART (in millions)				
CATEGORY	FIXE	PERMIT	O&	TOTAL
HNS				1440
		PROCURE	O&	
MOBS: STOL	N/A	$36.75	$65.00	$101.75
MOBS: MULTIMS	N/A	$66.25	$105.00	$171.25

NOTE: Procurement cost for MOBS spread over 20 years

EQUIVALENT CUBIC FEET (in millions)					NETWORK
CATEGORY	L. CARGO	D. CARGO	PERS	TOTAL	VALUE
HNS				337.476	85
MOBS: STOL	2.278	3.582	0.086	5.946	7
MOBS: MULTIMS	4.556	6.098	0.173	10.827	12

CONFLICT	CONFLICT LEVEL PROBABILITY			HNS PROBABILITY			TAU PROBABILITY		
	MOBS CONFIGURATION			MOBS CONFIGURATION			MOBS CONFIGURATION		
LEVEL	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS
LEVEL 1	0.01	0.04	0.05	0.69	0.69	0.69	1	1	1
LEVEL 2	0.1	0.12	0.13	0.60	0.69	0.69	1	1	1
LEVEL 3	0.2	0.21	0.23	0.59	0.68	0.68	1	0.6	0.8
LEVEL 4	0.3	0.28	0.26	0.66	0.71	0.71	1	0.45	0.6
LEVEL 5	0.39	0.35	0.33	0.54	0.60	0.60	1	0.25	0.4
CHECK	1	1	1						

W=	10
V=	1

	RESULTS BY DECISION AND CONFLICT LEVEL					CUM. HNS	FINA
	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	PRO	RESUL
NO MOBS	514.24	627.30	743.39	819.24	970.53	0.59	840.83
STOL	540.05	585.14	747.26	863.08	1040.59	0.66	854.61
MULTIMS	554.67	599.76	757.67	888.26	1076.74	0.66	866.24

Figure 15 Spreadsheet Input Values and Results Tabulation

COMBINED HOST NATION DATA COMPLATION

	COSTS	ECF	NV
HN1	225	14	12
HN2	865	252	43
HN3	350	71	30
TOTAL	1440	337	85

COMBINED HNS ECF	1187

HNS PROBABILITY OF SUPPORT COMPLATION						EFF COMPLATION	
NONE	WPROB	STOL	WPROB	MM	WPROB		TAU
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
1.00	0.57	1.00	0.57	1.00	0.57	682	1.00
0.00	0.00	0.00	0.00	0.00	0.00	371	1.00
	0.69		0.69		0.69	1187	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.80	0.46	0.90	0.52	0.90	0.52	648	0.95
0.10	0.03	0.20	0.06	0.20	0.06	334	0.90
	0.60		0.69		0.69	1116	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.50	0.29	0.60	0.34	0.60	0.34	546	0.80
0.60	0.19	0.70	0.22	0.70	0.22	260	0.70
	0.59		0.68		0.68	940	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.40	0.23	0.50	0.29	0.50	0.29	443	0.65
1.00	0.31	1.00	0.31	1.00	0.31	186	0.50
	0.66		0.71		0.71	763	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.20	0.11	0.30	0.17	0.30	0.17	307	0.45
1.00	0.31	1.00	0.31	1.00	0.31	130	0.35
	0.54		0.60		0.60	571	

Figure 16 Spreadsheet Model HNS Probability Distribution And Effectiveness Compilations

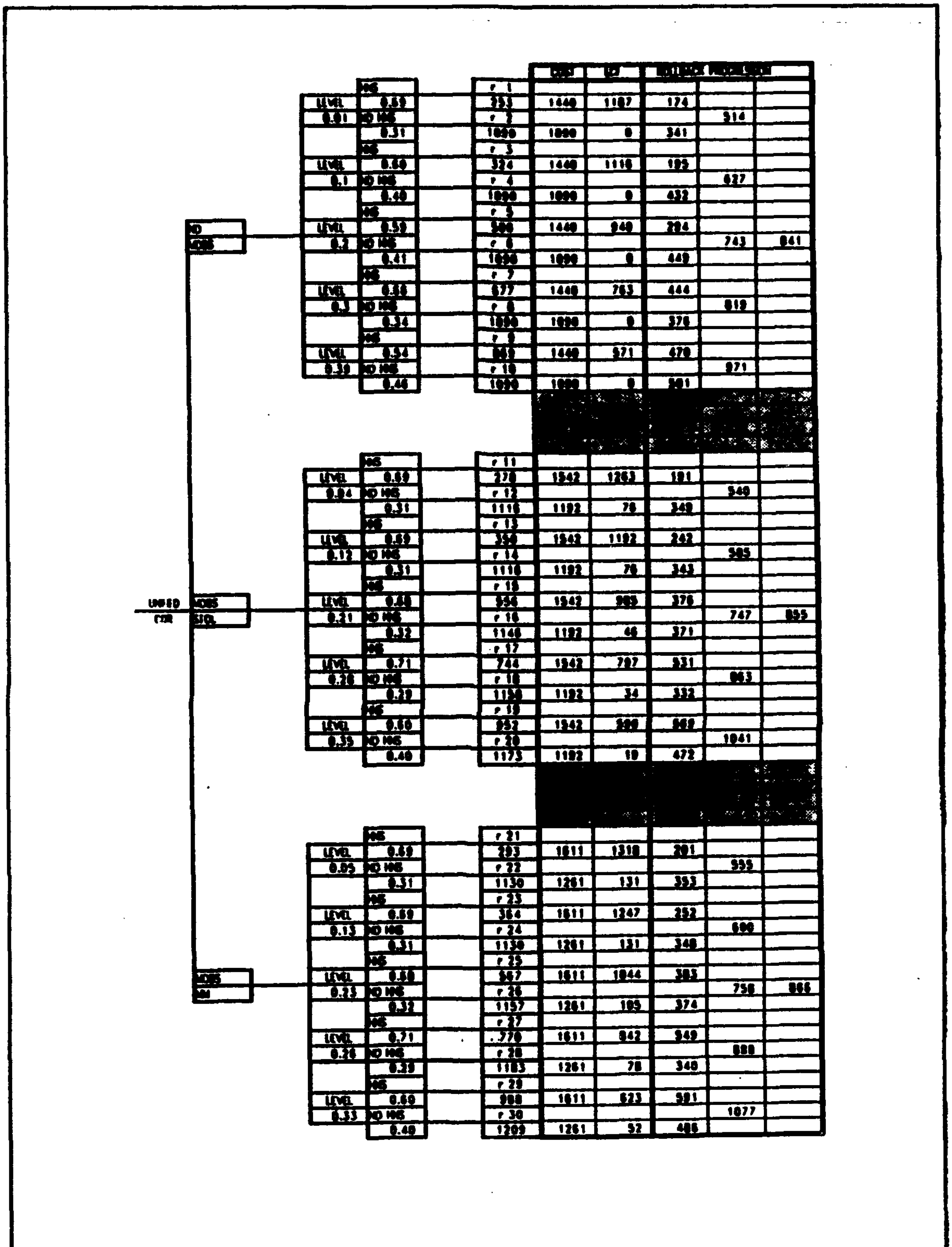

Figure 17 Spreadsheet Model Decision Tree and Rollback Compilation

DATA program and the resulting threshold values are shown in Figures 13 & 14.

Note that, for this case study, only a slight increase in **w** or **V** will result in a change to the recommended policy for the conditions described. It is up to the DM to decide where the threshold level lies.

D. ADDITIONAL CASE STUDIES AND ANALYSIS

A total of six iterations of the model were completed. The first was described in the previous section. The second and third involved the same three host nations and MOBS configurations vs. Hostile States 2 and 3 respectively. The remaining three runs involved assessing the impact on policy of varying the HNS network by successive removal of a different host nation in the Hostile State 1 scenario.

The objective in presenting the variations on the original scenario is to provide a sample of the range of information that analysis of the model output can provide.

1. Decision Space Comparison by Hostile State

Figures 18 and 19 depict the threshold shifts for **w** and **V** with a change in the Hostile State (i.e. variation on the Conflict Level distribution). Note that with Hostile State 1, the MOBS thresholds are well to the right of

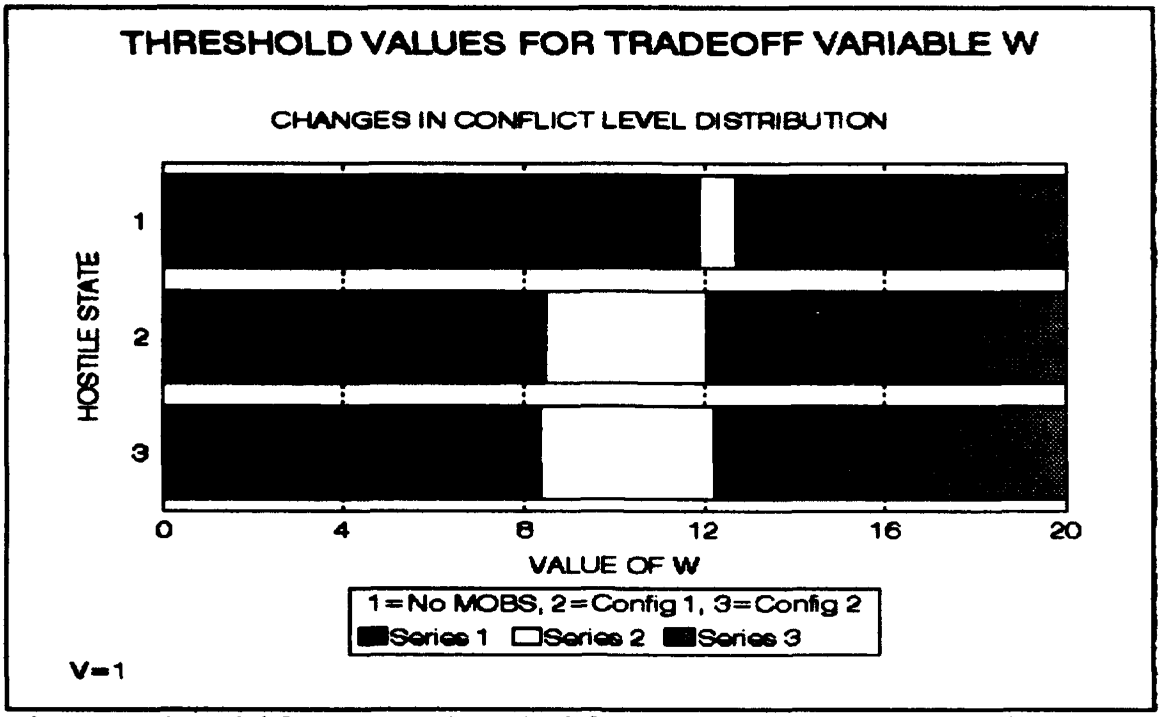

Figure 18 Shift In **w** Threshold With Change In Conflict Level Distribution

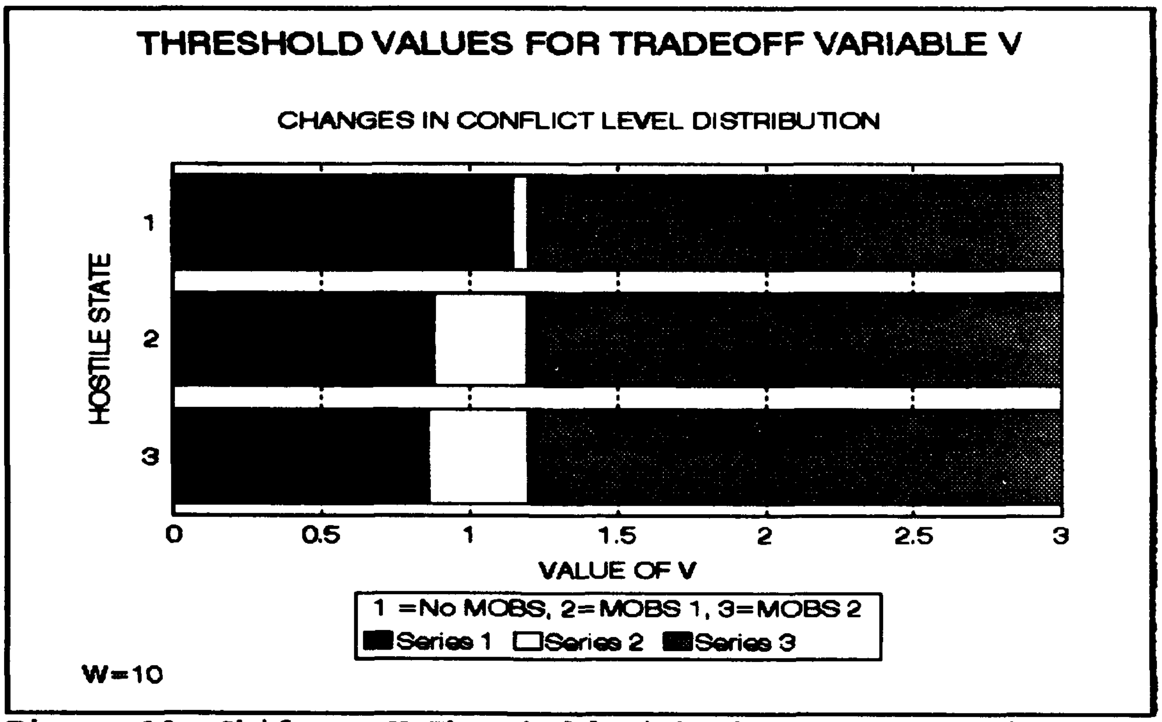

Figure 19 Shift In **V** Threshold With Change In Conflict Level Distribution

those for Hostile States 2 and 3. MOBS fairs less well with Hostile State 1, where the probability of escalation is high, primarily because of the low vulnerability factor **T**.

2. Threshold Shift With Network Structure Change

Regarding **w**, the loss of Host Nation 3 results in a shift of thresholds to the left, more in favor of MOBS. With the loss of Host Nations 2 or 3, MOBS 1 is eliminated from the decision space and MOBS 2 becomes a more attractive alternative.

Note also that when Host Nation 3 is removed, the threshold for MOBS 1 drops below 10, which makes MOBS 1 the preferred policy in that instance for **V** fixed at 1 and **w** fixed at 10. The trends for **V** are similar to those for **w** with the exception of the situation where Host Nation 1 is removed from the network. In that instance, there is slight shift to the right. When Host Nation 2 is eliminated, again, MOBS 1 is removed from the decision space.

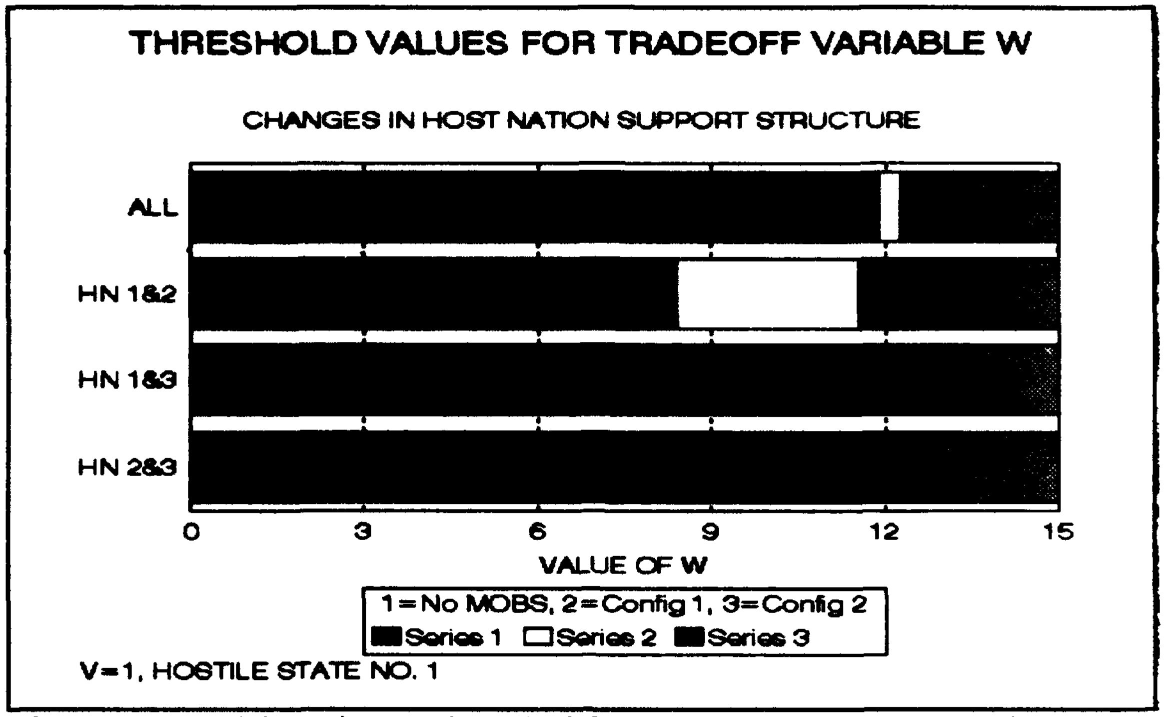

Figure 20 Shift in **w** Threshold Values With Host Nation Support Structure Change

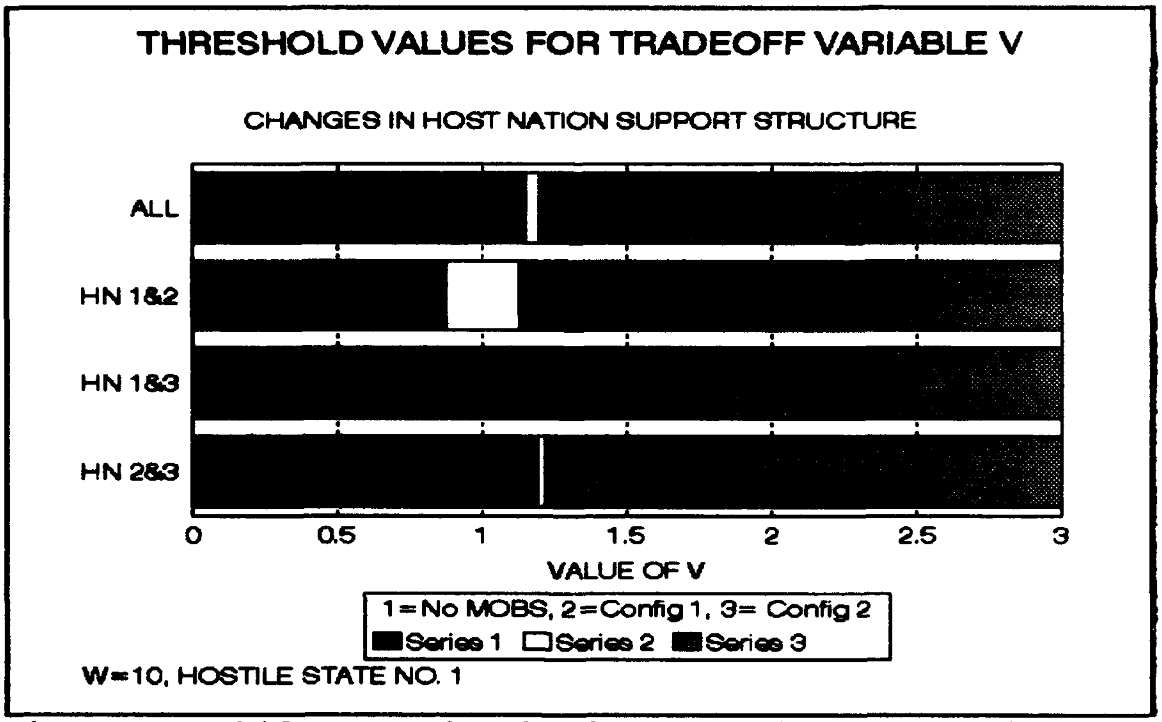

Figure 21 Shift In **V** Threshold Values With Host Nation Support Structure Change.

3. Shifts in Threshold Values With Increasing T

An ***increase*** in the MOBS vulnerability factor **T** results from a ***decrease*** in MOBS vulnerability. As **T** increases, it is reasonable to expect that MOBS would become a more attractive alternative and a shift to the left would be anticipated on the threshold diagrams. The degree of that shift is depicted in Figures 22 and 23.

The vulnerability factor was increased first by 10% and then 30% above the baseline value (up to 1.0). At 30%, a change in policy is indicated by both **w** and **V** to MOBS 1 as the preferred alternative.

This information can be useful in gauging the marginal return for increasing MOBS defensive capabilities or the level of protection required from other units.

4. Host Nation Support Probability

Built into the spreadsheet model is a mechanism which returns the composite of the conditional HNS probabilities. By noting changes in these values as host nations are considered for deletion from the network, the impact on the network as a whole can be gauged.

Refer to the Table VI. Note that the probability of HNS generally declines when a host nation is deleted. For instance, when Host Nation 3 is deleted, the probability declines five percent for the No MOBS situation (from 59% to 54%).

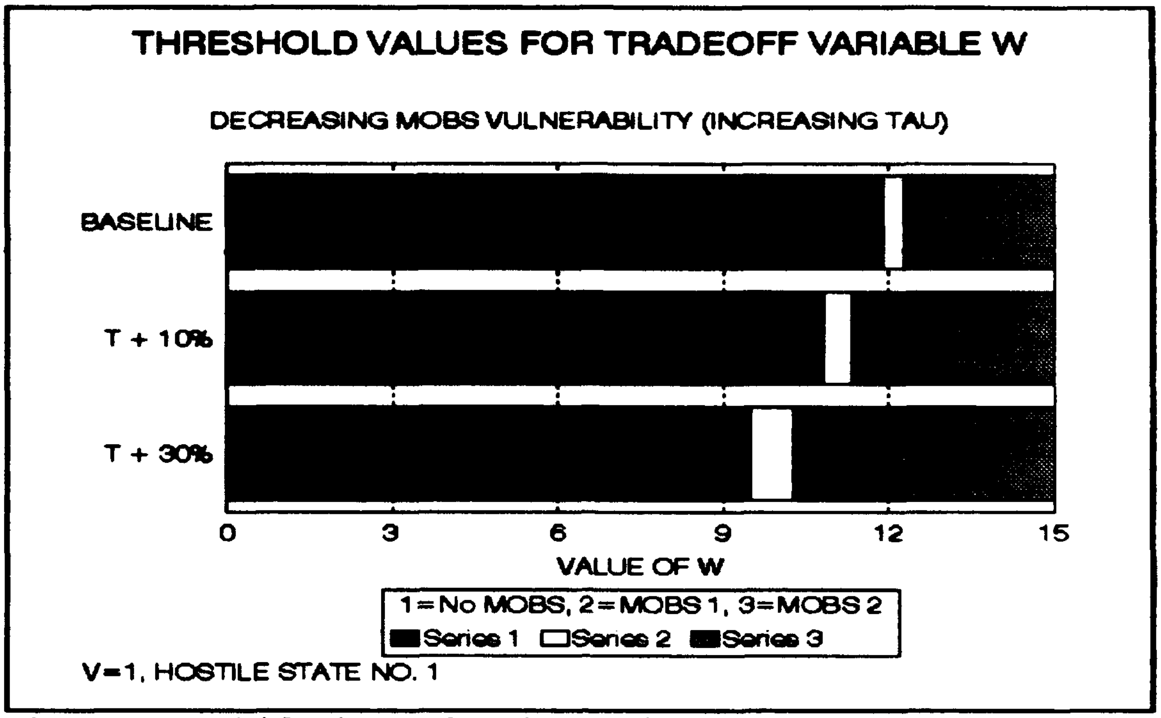

Figure 22 Shift in w Threshold With Decreasing MOBS Vulnerability

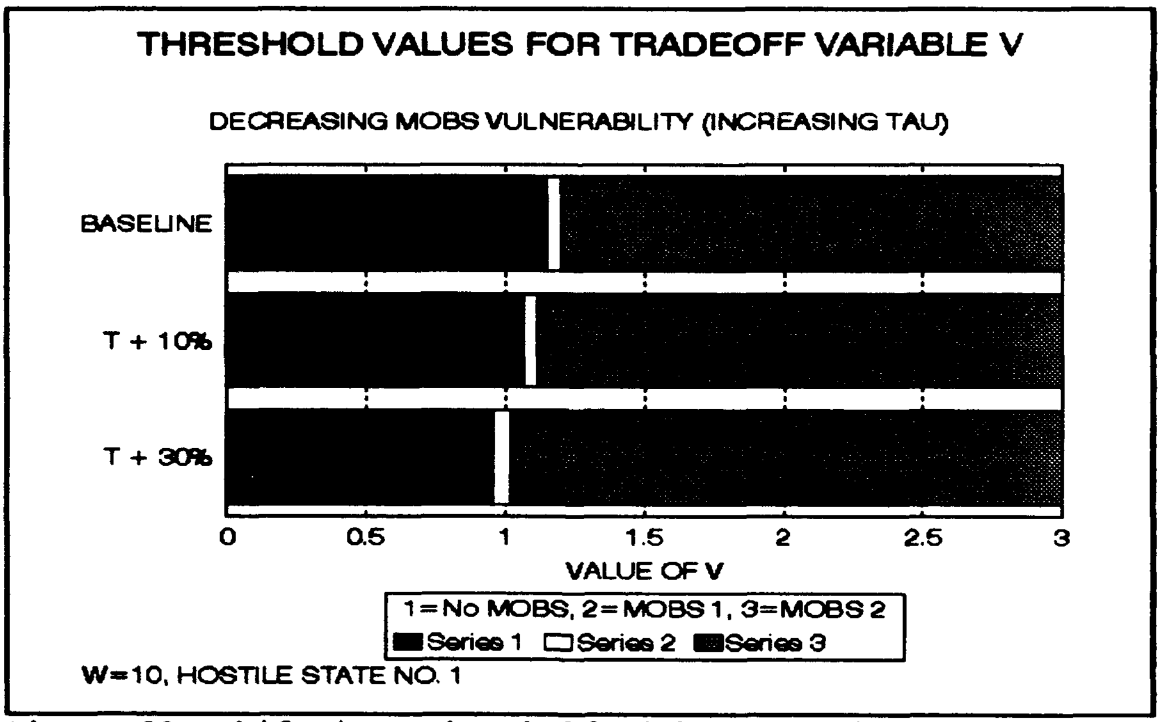

Figure 23 Shift in V Threshold With Decreasing MOBS Vulnerability

Table VI VARIATION IN HOST NATION SUPPORT PROBABILITIES WITH VARYING NETWORK STRUCTURES

MOBS CONFIGURATION	HOST NATION PROBABILITY OF SUPPORT			
	HOST NATION COMBINATIONS			
	1,2,3	1,2	1,3	2,3
NO MOBS	0.59	0.54	0.87	0.49
MOBS 1	0.66	0.62	0.85	0.60
MOBS 2	0.66	0.62	0.84	0.61

The exception is the instance when Host Nation 2 is removed from the network and the host nation support probability increases from 59% to 87% for the No MOBS policy. This anomaly exists due to the fact that the support Host Nation 2 provides is unreliable. Although the probability of support increases when Host Nation 2 is deleted, its absence results in a substantial loss in capability.

The most significant decline, not surprisingly, is felt with the loss of Host Nation 1, the staunch ally. The loss of Host Nation 3 has a slightly smaller impact.

E. SUMMARY

Provided in the previous section is a sample of the types of analysis that the decision model affords. A wide variety of "what if" scenarios can be generated with

relative ease once the basic structure is established in either a spreadsheet model or with made-for-use decision analysis software.

Experience with both has shown that the best alternative is to use both spreadsheet and decision tree formats. Spreadsheets offer the ability to rapidly alter, add, or delete inputs. Decision analysis software, such as DATA, provide a number of built-in tools which rapidly perform sensitivity analysis and present the outcome in graphical form.

V. CONCLUSIONS AND RECOMMENDATIONS

A. THE MODEL

Recall that the objectives in building this model were:

1. To develop an end-use perspective on MOBS.

2. To provide a pilot model for use if MOBS development proceeds.

3. To provide a means of assessing the efficacy of pursuing MOBS development.

Decision analysis is a useful tool in assessing the importance of MOBS for effective mission support. The model incorporates the evaluation of all of the fundamental variables involved in an intuitive, realistic, and reproducible format. It captures the key political and practical interactions inherent in a decision which necessarily involves a high degree of uncertainty and risk. The DM is given a clear look at critical trade-offs and the sensitivity of the value of key variables.

The model conveys the implications involved in deploying MOBS to a specific region rather than specifics on <u>how</u> it might be employed.

Finally, the model provides insight on pursuing further development of the MOBS concept.

The several instances described where deployment of MOBS in one of its configurations was the preferred policy are perhaps less revealing than the threshold in the trade-off values. In many instances, the range of values for the "No MOBS" policy, though selected as the optimum, was remarkably narrow.

This decision analysis model is intended as an aid in the selection of MOBS deployment sites, not a complete solution. It provides an easily implemented, supplemental and independent tool for evaluating deployment sites from an insightful and useful perspective.

B. APPLICABILITY OF DECISION ANALYSIS

Decision Analysis has found broad application in private industry and government. Of the various forms of the practice and methodology available, probability-based decision analysis remains the most analytically rigorous and provides results which are measurable, tractable, and defensible.

This model has shown that complex interactions of multiple variables can be incorporated into a relatively simple probabilistic model which produces realistic, practical results.

C. ON MOBS

The redundancy and capacity of our overseas basing network will continue to decline by several thousand sites in the next few years. Prepositioning, surge sealift, and airlift offer only partial solutions. The *Mobility Requirements Study* states:

> The National Military Strategy...requires that the United States deploy a decisive force either as a member of a coalition or unilaterally and sustain it in parts of the world where adequate pre-positioned equipment or bases may not be available and where the capability to support the force once it has arrived is limited [Ref. 18].

In the past, technology has made a decrease in redundancy acceptable, primarily by the increasing range of aircraft. Apart from the C-17 program, there are no such technological advancements on the immediate horizon. The wing-in-ground-effect aircraft holds some promise in this regard but it is too many years away to realize its contribution to overseas basing.

The technology necessary for the production and deployment of MOBS is well-founded and the materials relatively inexpensive and widely available. This, along with a trend of increasing permit costs and the often tentative provision of Host Nation support, combines to make MOBS an increasingly practical and fiscally sound alternative to land-based systems.

The model highlights the issue of vulnerability for MOBS. If the basic tenets utilized in the determination and use of Tau (the vulnerability factor) are accepted, it is readily apparent that vulnerability is certainly a great concern. However, in the near term, U.S. military dominance is sufficient to mitigate the level of vulnerability against the majority of adversaries likely within the scope a regional conflict.

D. RECOMMENDATIONS

Increasing levels of complexity are introduced to the basic model with relative ease. What the analyst must realize is that the size of the model, (i.e. the number of end nodes), proliferates rapidly. A spreadsheet quickly becomes unmanageable as the level of complexity increases. Even commercial decision analysis software, such as DATA, becomes difficult to manage at these higher levels of complexity.

In any case, the purpose of the decision analysis is to provide insight for the DM. Unnecessarily complex models may not be efficient or desirable in meeting this purpose.

Additional applications of the model include the evaluation of potential land-based sites considered in the expansion of the overseas basing network. This can be accomplished simply by introducing the applicable data for the prospective Host Nation in the same manner as MOBS.

Further, it can be used to elicit the relative implications of the removal of existing base sites.

The model is recommended as a means to perform supplementary analysis of MOBS deployment options. When used in conjunction with more traditional evaluation techniques, model outputs can be compared and contrasted. As a result, the analyst can present the decision maker with a more thorough perspective on the requirements for, and implications of, their policy choice.

ENDNOTES

1. E.I.Hickey and P. Skarlatos, *Mobile Offshore Bases: Augmenting the Carrier Strike Group* (Brown & Root, Inc., [Study 10]: Washington D.C., 1991), p. 18.

2. L.B. Sohn and K. Gustafson, *The Law of the Sea* (West Publishing Co.: St Paul, 1984), condensed from Chapter 7.

3. James R. Blaker et al., *Global Basing (Task 3 Report), The Costs of U.S. Overseas Basing* (Hudson Institute [HI-3917-RR]: Alexandria, Oct. 1987), pg. 3.

4. Ibid., p. 10.

5. John F. Peel Brahtz, *Modularized Ocean Basing System- A United States Option in a Strategy of Discriminate Deterrence (Circa 2000)* (Naval Civil Engineering Laboratory [R-928]: Port Hueneme, Nov. 1989), p. X.

6. Hickey, p. 31.

7. Craig W. Kirkwood, "An Overview of Methods for Applied Decision Analysis," *Interfaces*, November-December 1992., Volume 22, Number 6, p. 28.

8. Kneale T. Marshall and Robert M. Oliver, *Decision Making and Forecasting*, unpublished manuscript, June, 1993.

9. Vira Chankong and Yacov Y. Haimes, *Multiobjective Decision Making Theory and Methodology*, (Elsevier Publishing Co., Inc., New York, 1983).

10. Marshall, pp. 10-11.

11. Marshall, pp. 11-12.

12. Captain Wayne P. Hughes, Jr. USN (Ret.), *Naval Forces In Joint Littoral Warfare*, Abstract of a presentation at the Military Operations Research Symposium, 22 June 1993.

13. Chankong, pp. 8-13.

14. Military Traffic Management Command Transportation Engineering Agency, *Logistics Handbook for Strategic Mobility Planning*, August 1989, Table 30 and Appendix E, pp. 63 and 130. The conversion factor for dry cargo is the weighted average for "Mixed Dry Cargo(Less A/C)" on p. 65.

15. James R. Blaker et al., *U.S. Global Basing (Task 4 Report) U.S. Basing Options*, Hudson Institute [HI-3916-RR], October 1987, p. 26 and Appendix C, Table 3. Blaker also describes the concept of network value in his book, *United States Overseas Basing, An Anatomy of the Dilemma*. New York: Praeger Publishers, 1990, pp.59-82.

16. Captain Wayne P. Hughes, Jr. USN (Ret), *Fleet Tactics theory and practice*. Annapolis: Naval Institute Press, 1986, pp. 254-264. "The Value of Warship Attributes". Monterey: Naval Postgraduate School, an unpublished presentation, pp. 1-16, particularly p. 9.

17. Chankong, p. 90.

18. Executive summary, *Mobility Requirements Study, Volume I* p. ES-2.

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APPENDIX A

NETWORK VALUE

BASE EVALUATIONS AND NETWORK ANALYSIS

To evaluate bases, we have adopted some of the insights and techniques of what is known as network analysis. This approach, growing out of the systems analysis movement of the 1960s, has been developed into one of the most useful modes of analysis, particularly as computer assisted simulations grew in the 1970s and 1980s. We have drawn from the work of Burt, Elmaghroby, Gordon, and Pritsker for the adaptation of the approach used in this assessment.*

The basic assumption of our assessment is that the interactions (either actual or potential) between base sites form a network through which military manpower, materiel, and information flow. As a network, this can be modeled and network theory and measurements can be applied to identify (1) existing and potential interactions among base sites, (2) the extent to which any base is capable of providing men, materiel, or information to any other base, and, (3) the relative value of any given base site to all other base sites, in terms of providing men, materiel, and information.

Using network terminology, a base site is referred to as a node, the flows of materiel and manpower between nodes are referred to as transactions, and the connections among the nodes are referred to as branches. Nodes and transactions have attributes that can be expressed quantitatively.

Transactions, for example, can be expressed in numbers of men, volume, or weights of materiel, or numbers of bits of information transferred in a given time. These transactions can be expressed in some of the measures commonly used to analyze combat operations (eg: combat radii of a given weapons system) or peacetime logistics operations (eg: airlift sorties). Nodes can be expressed in terms of capacities to receive, process, and send on men, materiel, or communications. While a wide range of measures could be used to express transactions and nodes, we have used the following:

- numbers of C-141 sorties transferred and processed within 24 hours

- tonnages of sealift transferred and processed within 96 hours

- numbers of F-16 fighter sorties generated within 24 hours

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* J. M. Burt, et. al., "Simple Stochastic Networks: Some Problems and Procedures," Naval Reserve Logistics Quarterly, Vol. 17, (December 1970), pp. 439-460; S. E. Elmaghroby, The Design of Production Systems (New York: Reinhold Publishing Corporation, 1966); G. Gordon, System Simulation, (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1969); A. Pritsker, Modeling and Analysis Using Q-GERT Networks (New York: John Wiley & Sons, 1977).

- numbers of carrier battle groups transferred and processed within 48 hours

- numbers of tank battalions transferred and processed within 8 hours

Branches, or the connections between base sites that constitute the basing network can be modeled in terms of rules; that is, branches among base sites can be said to exist, either actually or potentially, if it is possible to make transactions between base sites within certain time and distance parameters. This analysis assumed branches under the following rules:

- A branch can exist only if the sending and receiving nodes (base sites) have common characteristics (if the "transaction" involves C-141 sorties, both must have airfields capable of supporting C-141 aircraft; if the "transaction" involves carrier battle groups, each must have port facilities or airfields capable of supporting carrier based combat aircraft within 100 miles of carrier operating areas).

- A branch can exist if the sending and receiving nodes are within certain distances from each other, i.e.:

  -- within 200 miles of the critical leg distance of the C-141; (in effect, base sites capable of receiving C-141 aircraft were considered a network if they were within 2800 to 3200 miles of each other).

  -- within 3 days sailing time of Maritime Prepositioning Ships; (in effect, base sites capable of receiving sealift were considered a network if they were within 1000 miles).

  -- within the combat radius (high-low-high) of F-16 fighter aircraft; (in effect, all airfields capable of receiving F-16 aircraft within 575 miles were considered an actual or potential network).

  -- within 8 hours of the road march distance of an armored column in an administrative movement; (in effect, base sites containing fuel and bivouac space within 70 miles).

  -- within the normal operating radius of the UH-60A helicopter. (in effect, all base sites within 350 miles).

The parameters selected for transactions and rules for branching were based on operational considerations. Theoretically, of course, it is possible for men or materiel to be transferred among any of the U.S. base sites abroad. The greater the distances between the nodes, however, the less

that can be transferred by air and the longer it takes to do so by any mode of transport. Network analysis can deal with these nuances, but for practical reasons we imposed time and distance parameters that coincide with planning assumptions used for operations involving military systems that will remain representative of the U.S. inventories over the next decade. The critical leg distance of the C-141, for example, is the major template used in planning airlift operations, not because C-141s are not used at lesser or greater ranges, but because this is the range at which airlift using this system is most efficient. Likewise, the combat operational range of the F-16 and normal operating range of the UH-60A helicopter, and the 8 hour transit distance of an armored column are reasonable and useful planning parameters, and, as such, have been adopted in this assessment.

APPENDIX B

PULSED POWER EQUATION DERIVATION

The following is a brief summary of the evolution of the Pulsed Power Equation from the Lanchester Square Law.

Lanchester Square Law State Equation:

$$b(A_o^2 - A_t^2) = a(B_o^2 - B_t^2)$$

where: **a** is the attrition coefficient for force **A**
b is the attrition coefficient for force **B**
A_o is the number of original **A** forces
B_o is the number of original **B** forces
A_t are the remaining **A** forces
B_t are the remaining **B** forces

J.V. Chase Difference Equations:

$$\frac{d(a_1 A)}{dt} = -b_2 B \quad \text{and} \quad \frac{d(b_1 B)}{dt} = -a_2 A$$

where: a_1 is the **A** unit staying power
b_1 is the **B** unit staying power
a_2 is the **A** unit striking power
b_2 is the **B** unit striking power
A & **B** are the number of **A** and **B** forces originally available

Fiske Salvo Equations:

$$\Delta A = \frac{b_2 B}{a_1} \quad \text{and} \quad \Delta B = \frac{a_2 A}{b_1}$$

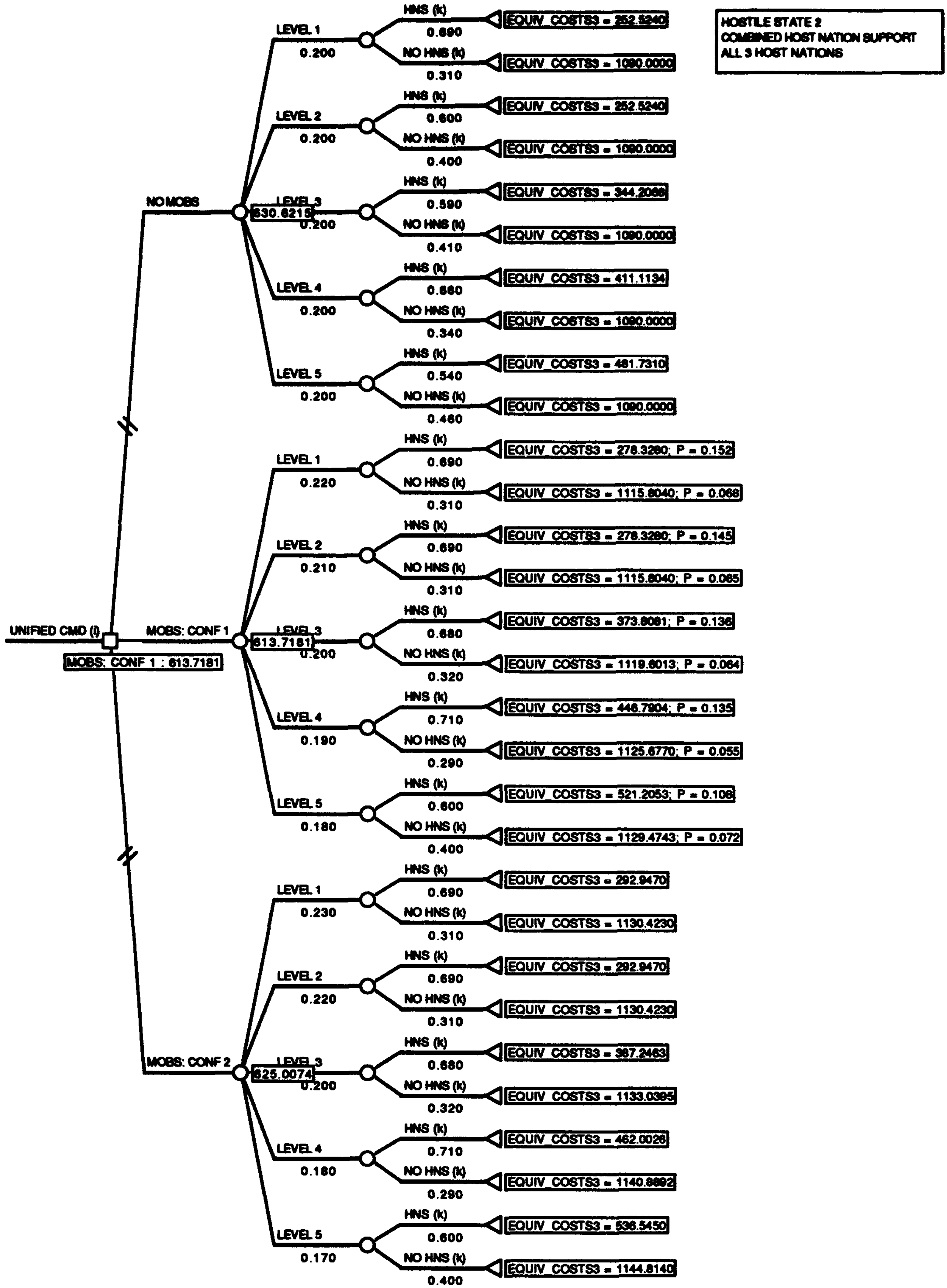
Pulsed Power Equation:

$$\Delta A = \frac{\sigma_B b_2 B - \tau_A a_3 A}{a_1}$$

where: a_3 is the **A** unit defensive power

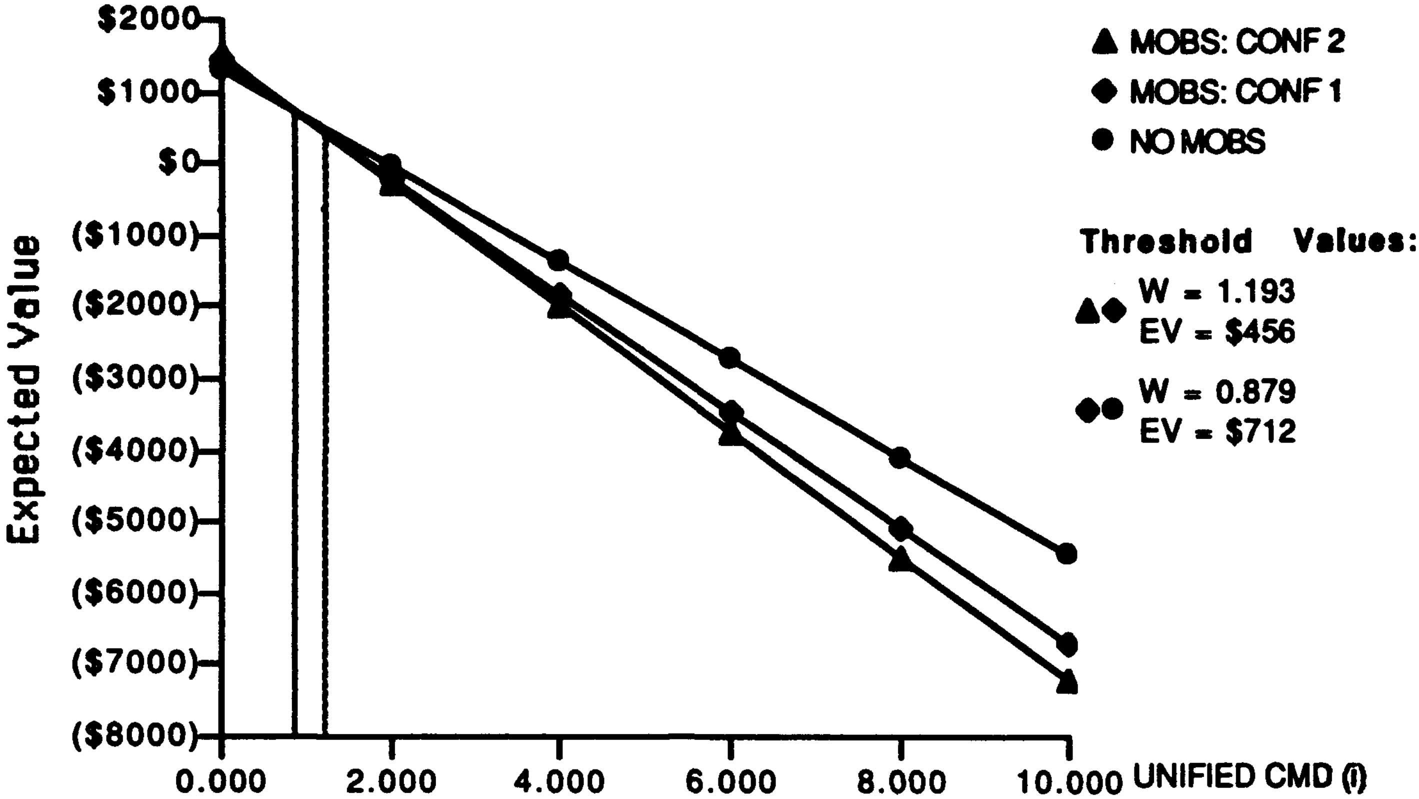
APPENDIX C

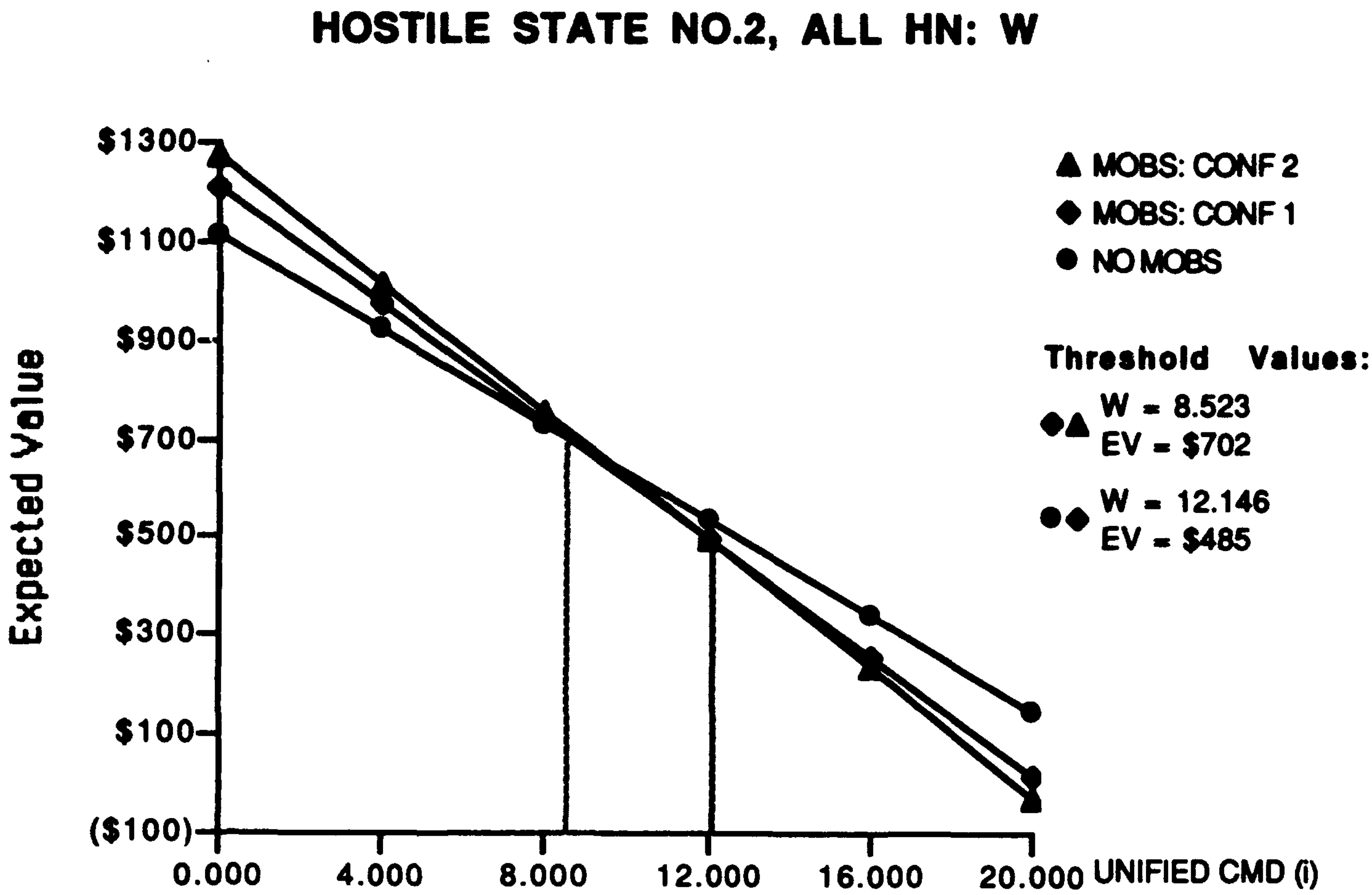
MOBS DEPLOYMENT MODEL TEST CASE RESULTS
SPREADSHEET AND TREE AGE MODELS



HOSTILE STATE 2
COMBINED HOST NATION SUPPORT
ALL 3 HOST NATIONS
UNIFIED CMD (I)
MOBS: CONF 1 : 613.7181
NO MOBS
630.6215
LEVEL 1
0.200
HNS (k)
0.690
EQUIV_COSTS3 = 252.5240
NO HNS (k)
0.310
EQUIV_COSTS3 = 1090.0000
LEVEL 2
0.200
HNS (k)
0.600
EQUIV_COSTS3 = 252.5240
NO HNS (k)
0.400
EQUIV_COSTS3 = 1090.0000
LEVEL 3
0.200
HNS (k)
0.590
EQUIV_COSTS3 = 344.2066
NO HNS (k)
0.410
EQUIV_COSTS3 = 1090.0000
LEVEL 4
0.200
HNS (k)
0.660
EQUIV_COSTS3 = 411.1134
NO HNS (k)
0.340
EQUIV_COSTS3 = 1090.0000
LEVEL 5
0.200
HNS (k)
0.540
EQUIV_COSTS3 = 481.7310
NO HNS (k)
0.460
EQUIV_COSTS3 = 1090.0000
MOBS: CONF 1
613.7181
LEVEL 1
0.220
HNS (k)
0.690
EQUIV_COSTS3 = 278.3280; P = 0.152
NO HNS (k)
0.310
EQUIV_COSTS3 = 1115.8040; P = 0.068
LEVEL 2
0.210
HNS (k)
0.690
EQUIV_COSTS3 = 278.3280; P = 0.145
NO HNS (k)
0.310
EQUIV_COSTS3 = 1115.8040; P = 0.065
LEVEL 3
0.200
HNS (k)
0.680
EQUIV_COSTS3 = 373.8081; P = 0.136
NO HNS (k)
0.320
EQUIV_COSTS3 = 1119.6013; P = 0.064
LEVEL 4
0.190
HNS (k)
0.710
EQUIV_COSTS3 = 446.7904; P = 0.135
NO HNS (k)
0.290
EQUIV_COSTS3 = 1125.6770; P = 0.055
LEVEL 5
0.180
HNS (k)
0.600
EQUIV_COSTS3 = 521.2053; P = 0.108
NO HNS (k)
0.400
EQUIV_COSTS3 = 1129.4743; P = 0.072
MOBS: CONF 2
625.0074
LEVEL 1
0.230
HNS (k)
0.690
EQUIV_COSTS3 = 292.9470
NO HNS (k)
0.310
EQUIV_COSTS3 = 1130.4230
LEVEL 2
0.220
HNS (k)
0.690
EQUIV_COSTS3 = 292.9470
NO HNS (k)
0.310
EQUIV_COSTS3 = 1130.4230
LEVEL 3
0.200
HNS (k)
0.680
EQUIV_COSTS3 = 387.2463
NO HNS (k)
0.320
EQUIV_COSTS3 = 1133.0395
LEVEL 4
0.180
HNS (k)
0.710
EQUIV_COSTS3 = 462.0026
NO HNS (k)
0.290
EQUIV_COSTS3 = 1140.8692
LEVEL 5
0.170
HNS (k)
0.600
EQUIV_COSTS3 = 536.5450
NO HNS (k)
0.400
EQUIV_COSTS3 = 1144.8140

HOSTILE STATE NO. 2, ALL HN: V





HOSTILE STATE NO.2, ALL HN: W
$1300
$1100
$900
$700
$500
$300
$100
($100)
Expected Value
0.000
4.000
8.000
12.000
16.000
20.000
UNIFIED CMD (i)
MOBS: CONF 2
MOBS: CONF 1
NO MOBS
Threshold Values:
W = 8.523
EV = $702
W = 12.146
EV = $485

HOSTILE STATE NO. 2	COMBINED HOST NATION SUPPORT

ANNUAL COSTS CHART (In millions)				
CATEGORY	FIXE	PERMIT	O&M	TOTAL
HNS				1440
		PROCURE	O&M	
MOBS: STOL	N/A	$36.75	$65.00	$101.75
MOBS: MULTIMS	N/A	$66.25	$105.00	$171.25

NOTE: Procurement cost for MOBS spread over 20 years

EQUIVALENT CUBIC FEET (In millions)					NETWORK
CATEGORY	L. CARGO	D. CARGO	PERS	TOTAL	VALUE
HNS				337.476	85
MOBS: STOL	2.278	3.582	0.086	5.946	7
MOBS: MULTIMS	4.556	6.098	0.173	10.827	12

CONFLICT LEVEL	CONFLICT LEVEL PROBABILITY			HNS PROBABILITY			TAU PROBABILITY		
	MOBS CONFIGURATION			MOBS CONFIGURATION			MOBS CONFIGURATION		
	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS
LEVEL 1	0.2	0.22	0.23	0.69	0.69	0.69	1	1	1
LEVEL 2	0.2	0.21	0.22	0.60	0.69	0.69	1	1	1
LEVEL 3	0.2	0.2	0.2	0.59	0.68	0.68	1	0.95	0.98
LEVEL 4	0.2	0.19	0.18	0.66	0.71	0.71	1	0.87	0.92
LEVEL 5	0.2	0.18	0.17	0.54	0.60	0.60	1	0.82	0.89
CHECK	1	1	1						

W=	10
V=	1

	RESULTS BY DECISION AND CONFLICT LEVEL					CUM. HNS	FINA
	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	PRO	RESUL
NO MOBS	514.24	584.29	651.65	645.11	761.27	0.61	631.31
STOL	540.05	535.81	615.10	641.79	765.80	0.68	614.14
MULTIMS	554.67	550.43	628.54	657.00	781.14	0.68	625.43

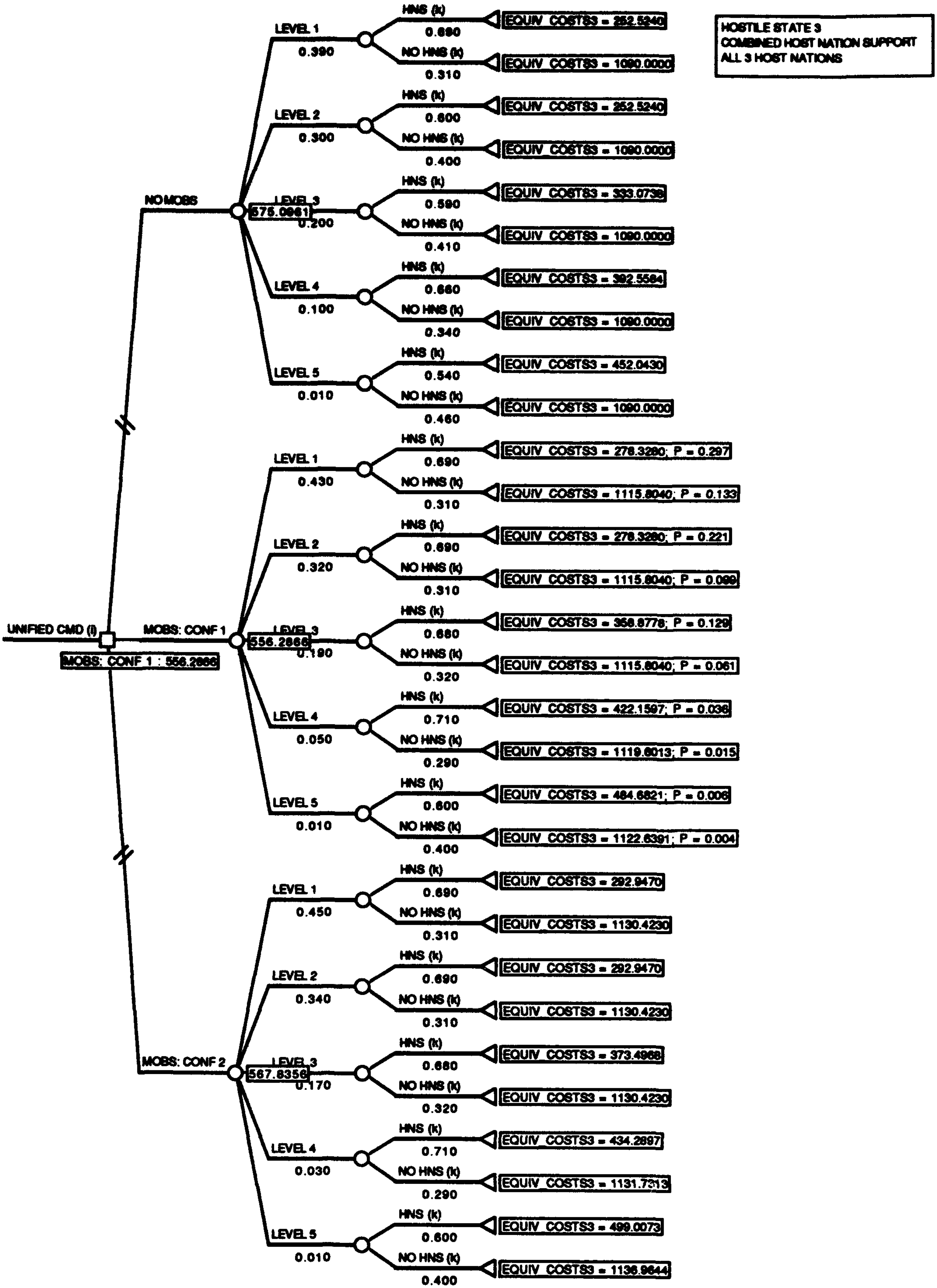
COMBINED HOST NATION DATA COMPLATION

	COSTS	ECF	NV
HN1	225	14	12
HN2	865	252	43
HN3	350	71	30
TOTAL	1440	337	85

COMBINED HNS ECF	1187

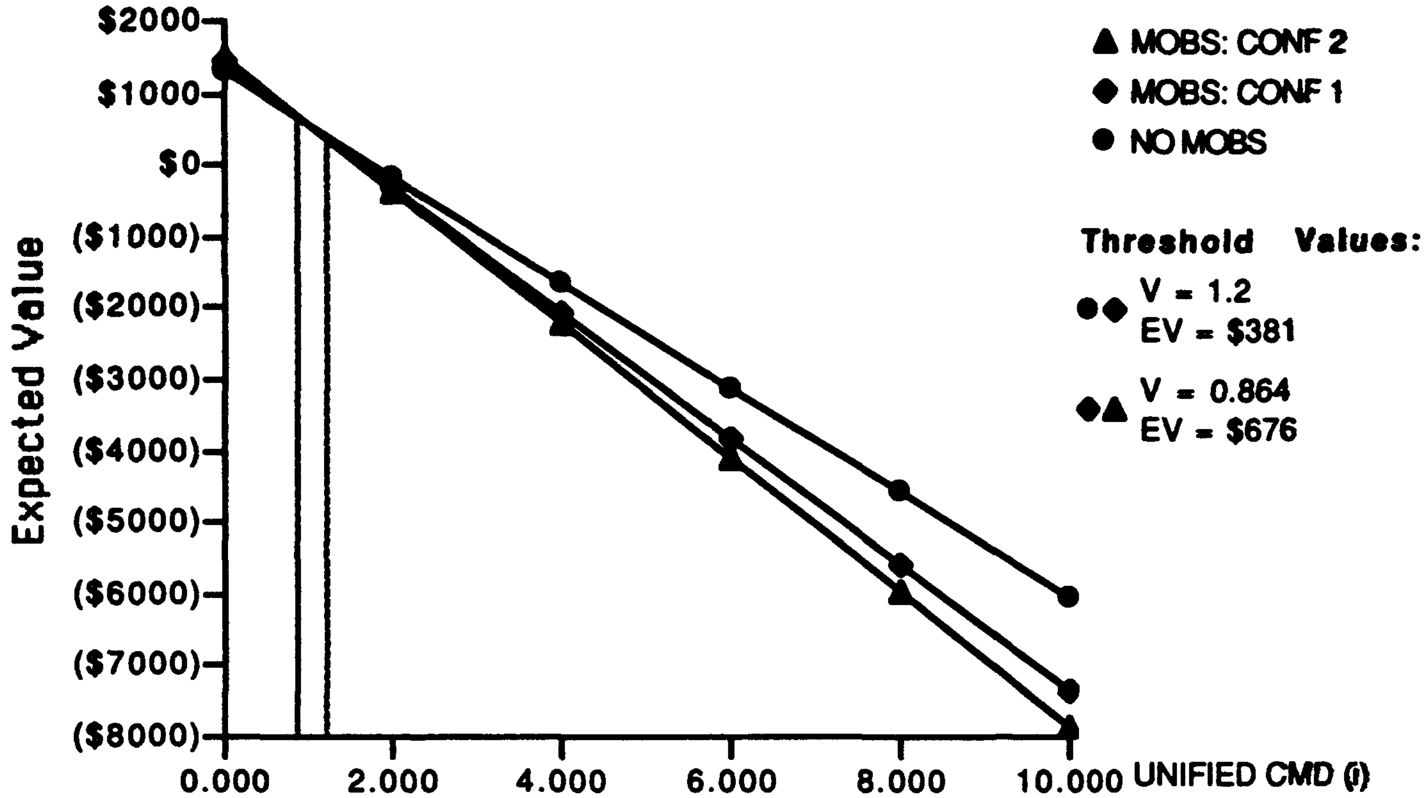
HNS PROBABILITY OF SUPPORT COMPLATION						EFF COMPLATION	
NONE	WPROB	STOL	WPROB	MM	WPROB		TAU
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
1.00	0.57	1.00	0.57	1.00	0.57	682	1.00
0.00	0.00	0.00	0.00	0.00	0.00	371	1.00
	0.69		0.69		0.69	1187	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.80	0.46	0.90	0.52	0.90	0.52	682	1.00
0.10	0.03	0.20	0.06	0.20	0.06	371	1.00
	0.60		0.69		0.69	1187	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.50	0.29	0.60	0.34	0.60	0.34	628	0.92
0.60	0.19	0.70	0.22	0.70	0.22	334	0.90
	0.59		0.68		0.68	1096	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.40	0.23	0.50	0.29	0.50	0.29	587	0.86
1.00	0.31	1.00	0.31	1.00	0.31	308	0.83
	0.66		0.71		0.71	1029	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.20	0.11	0.30	0.17	0.30	0.17	546	0.80
1.00	0.31	1.00	0.31	1.00	0.31	278	0.75
	0.54		0.60		0.60	958	

					COST	ECF	ROLLBACK PROGRESSION		
			HNS	r 1					
		LEVEL	0.69	253	1440	1187	174		
		0.2	NO HNS	r 2				514	
			0.31	1090	1090	0	341		
			HNS	r 3					
		LEVEL	0.60	253	1440	1187	152		
		0.2	NO HNS	r 4				584	
			0.40	1090	1090	0	432		
			HNS	r 5					
	NO	LEVEL	0.59	344	1440	1096	202		
	MOBS	0.2	NO HNS	r 6				652	631
			0.41	1090	1090	0	449		
			HNS	r 7					
		LEVEL	0.66	411	1440	1029	269		
		0.2	NO HNS	r 8				645	
			0.34	1090	1090	0	376		
			HNS	r 9					
		LEVEL	0.54	482	1440	958	260		
		0.2	NO HNS	r 10				761	
			0.46	1090	1090	0	501		
			HNS	r 11					
		LEVEL	0.69	278	1542	1263	191		
		0.22	NO HNS	r 12				540	
			0.31	1116	1192	76	349		
			HNS	r 13					
		LEVEL	0.69	278	1542	1263	193		
		0.21	NO HNS	r 14				536	
			0.31	1116	1192	76	343		
			HNS	r 15					
UNIFIED	MOBS	LEVEL	0.68	374	1542	1168	253		
CDR	STOL	0.2	NO HNS	r 16				615	614
			0.32	1120	1192	72	362		
			HNS	r 17					
		LEVEL	0.71	447	1542	1095	318		
		0.19	NO HNS	r 18				642	
			0.29	1126	1192	66	323		
			HNS	r 19					
		LEVEL	0.60	521	1542	1021	312		
		0.18	NO HNS	r 20				766	
			0.40	1129	1192	62	454		
			HNS	r 21					
		LEVEL	0.69	293	1611	1318	201		
		0.23	NO HNS	r 22				555	
			0.31	1130	1261	131	353		
			HNS	r 23					
		LEVEL	0.69	293	1611	1318	203		
		0.22	NO HNS	r 24				550	
			0.31	1130	1261	131	348		
			HNS	r 25					
	MOBS	LEVEL	0.68	387	1611	1224	262		
	MM	0.2	NO HNS	r 26				629	625
			0.32	1133	1261	128	367		
			HNS	r 27					
		LEVEL	0.71	462	1611	1149	329		
		0.18	NO HNS	r 28				657	
			0.29	1141	1261	120	328		
			HNS	r 29					
		LEVEL	0.60	537	1611	1075	321		
		0.17	NO HNS	r 30				781	
			0.40	1145	1261	116	460		

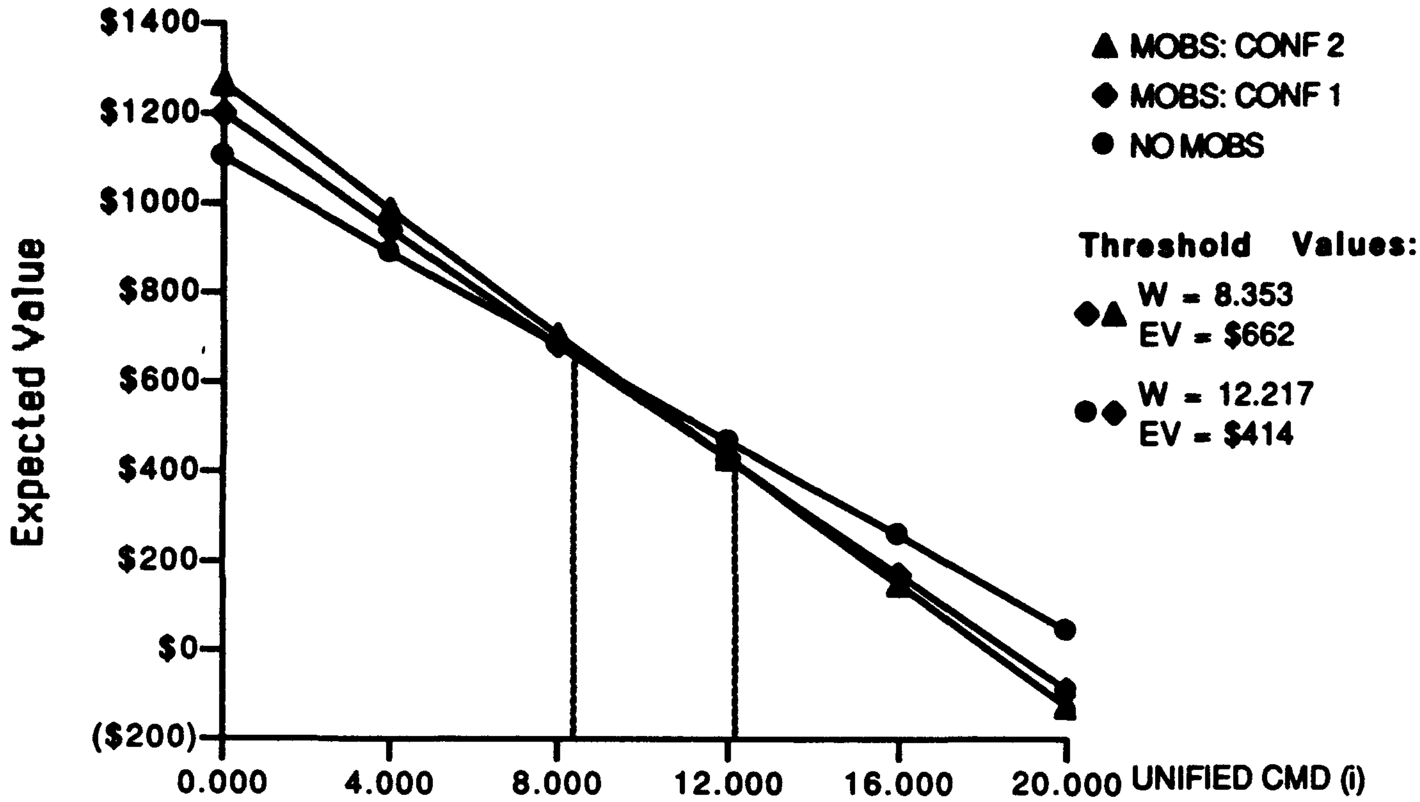


HOSTILE STATE 3
COMBINED HOST NATION SUPPORT
ALL 3 HOST NATIONS
UNIFIED CMD (i)
MOBS: CONF 1 : 556.2866
NO MOBS
575.0961
LEVEL 1
0.390
HNS (k)
0.690
EQUIV COSTS3 = 252.5240
NO HNS (k)
0.310
EQUIV COSTS3 = 1090.0000
LEVEL 2
0.300
HNS (k)
0.600
EQUIV COSTS3 = 252.5240
NO HNS (k)
0.400
EQUIV COSTS3 = 1090.0000
LEVEL 3
0.200
HNS (k)
0.590
EQUIV COSTS3 = 333.0736
NO HNS (k)
0.410
EQUIV COSTS3 = 1090.0000
LEVEL 4
0.100
HNS (k)
0.660
EQUIV COSTS3 = 392.5584
NO HNS (k)
0.340
EQUIV COSTS3 = 1090.0000
LEVEL 5
0.010
HNS (k)
0.540
EQUIV COSTS3 = 452.0430
NO HNS (k)
0.460
EQUIV COSTS3 = 1090.0000
MOBS: CONF 1
556.2866
LEVEL 1
0.430
HNS (k)
0.690
EQUIV COSTS3 = 278.3280; P = 0.297
NO HNS (k)
0.310
EQUIV COSTS3 = 1115.8040; P = 0.133
LEVEL 2
0.320
HNS (k)
0.690
EQUIV COSTS3 = 278.3280; P = 0.221
NO HNS (k)
0.310
EQUIV COSTS3 = 1115.8040; P = 0.099
LEVEL 3
0.190
HNS (k)
0.680
EQUIV COSTS3 = 358.8776; P = 0.129
NO HNS (k)
0.320
EQUIV COSTS3 = 1115.8040; P = 0.061
LEVEL 4
0.050
HNS (k)
0.710
EQUIV COSTS3 = 422.1597; P = 0.036
NO HNS (k)
0.290
EQUIV COSTS3 = 1119.6013; P = 0.015
LEVEL 5
0.010
HNS (k)
0.600
EQUIV COSTS3 = 484.6821; P = 0.006
NO HNS (k)
0.400
EQUIV COSTS3 = 1122.6391; P = 0.004
MOBS: CONF 2
567.8356
LEVEL 1
0.450
HNS (k)
0.690
EQUIV COSTS3 = 292.9470
NO HNS (k)
0.310
EQUIV COSTS3 = 1130.4230
LEVEL 2
0.340
HNS (k)
0.690
EQUIV COSTS3 = 292.9470
NO HNS (k)
0.310
EQUIV COSTS3 = 1130.4230
LEVEL 3
0.170
HNS (k)
0.680
EQUIV COSTS3 = 373.4968
NO HNS (k)
0.320
EQUIV COSTS3 = 1130.4230
LEVEL 4
0.030
HNS (k)
0.710
EQUIV COSTS3 = 434.2897
NO HNS (k)
0.290
EQUIV COSTS3 = 1131.7313
LEVEL 5
0.010
HNS (k)
0.600
EQUIV COSTS3 = 499.0073
NO HNS (k)
0.400
EQUIV COSTS3 = 1136.9644

HOSTILE STATE NO. 3, ALL HN:V



HOSTILE STATE NO. 3, ALL HN: W



HOSTILE STATE NO. 3	COMBINED HOST NATION SUPPORT

ANNUAL COSTS CHART (In millions)				
CATEGORY	FIXE	PERMIT	O&M	TOTAL
HNS				1440
		PROCURE	O&M	
MOBS: STOL	N/A	$36.75	$65.00	$101.75
MOBS: MULTIMS	N/A	$66.25	$105.00	$171.25

NOTE: Procurement cost for MOBS spread over 20 years

EQUIVALENT CUBIC FEET (In millions)					NETWORK
CATEGORY	L. CARGO	D. CARGO	PERS	TOTAL	VALUE
HNS				337.476	85
MOBS: STOL	2.278	3.582	0.086	5.946	7
MOBS: MULTIMS	4.556	6.098	0.173	10.827	12

CONFLICT LEVEL	CONFLICT LEVEL PROBABILITY			HNS PROBABILITY			TAU PROBABILITY		
	MOBS CONFIGURATION			MOBS CONFIGURATION			MOBS CONFIGURATION		
	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS
LEVEL 1	0.39	0.43	0.45	0.69	0.69	0.69	1	1	1
LEVEL 2	0.3	0.32	0.34	0.60	0.69	0.69	1	1	1
LEVEL 3	0.2	0.19	0.17	0.59	0.68	0.68	1	1	1
LEVEL 4	0.1	0.05	0.03	0.66	0.71	0.71	1	0.95	0.99
LEVEL 5	0.01	0.01	0.01	0.54	0.60	0.60	1	0.91	0.95
CHECK	1	1	1						

W=	10
V=	1

	RESULTS BY DECISION AND CONFLICT LEVEL					CUM. HNS	FINA
	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	PRO	RESUL
NO MOBS	514.24	584.29	645.11	632.95	745.23	0.64	575.61
STOL	540.05	535.81	603.77	622.49	741.22	0.69	556.94
MULTIMS	554.67	550.43	618.39	634.62	755.54	0.69	568.47

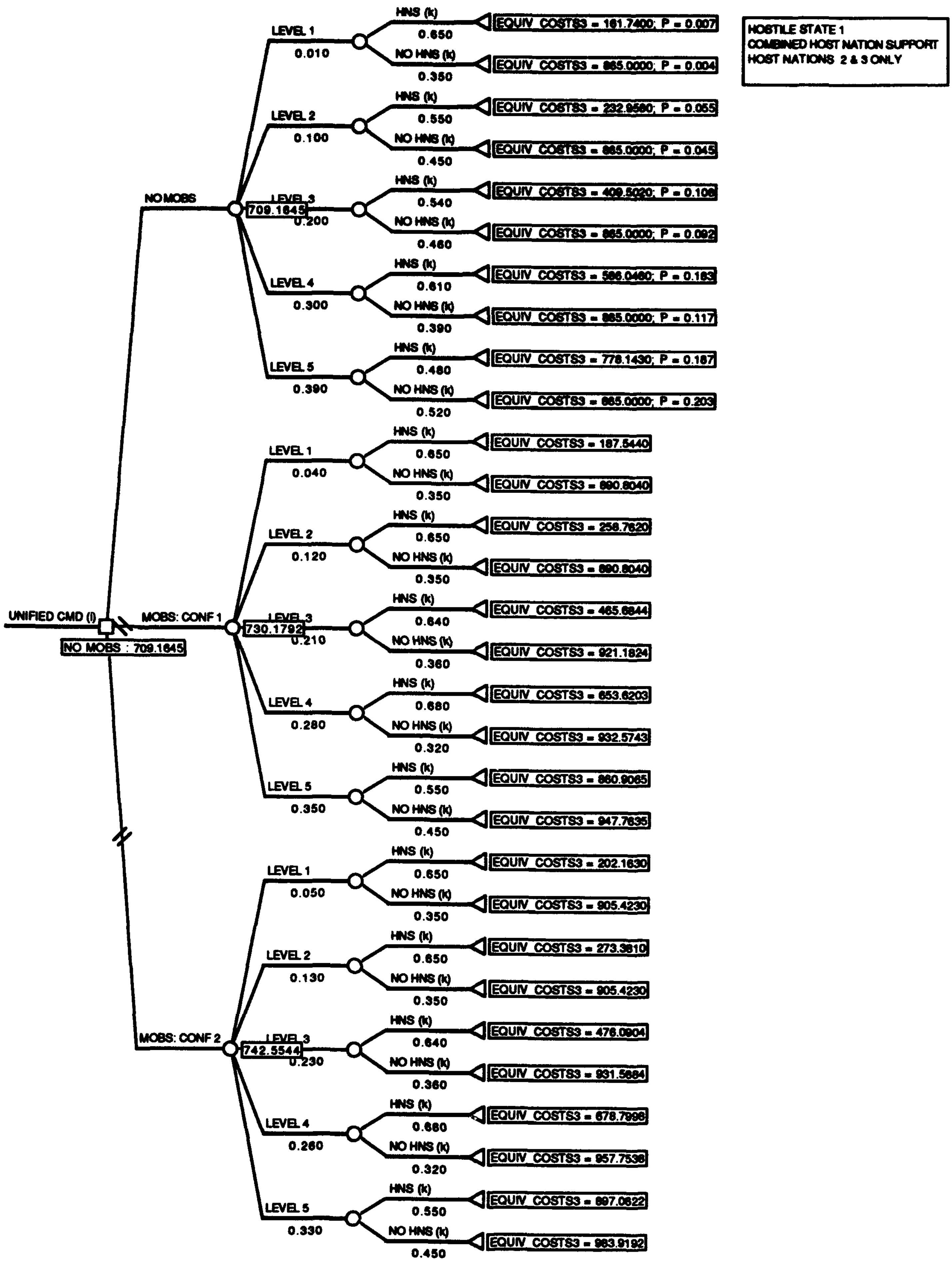
COMBINED HOST NATION DATA COMPLATION

	COSTS	ECF	NV
HN1	225	14	12
HN2	865	252	43
HN3	350	71	30
TOTAL	1440	337	85

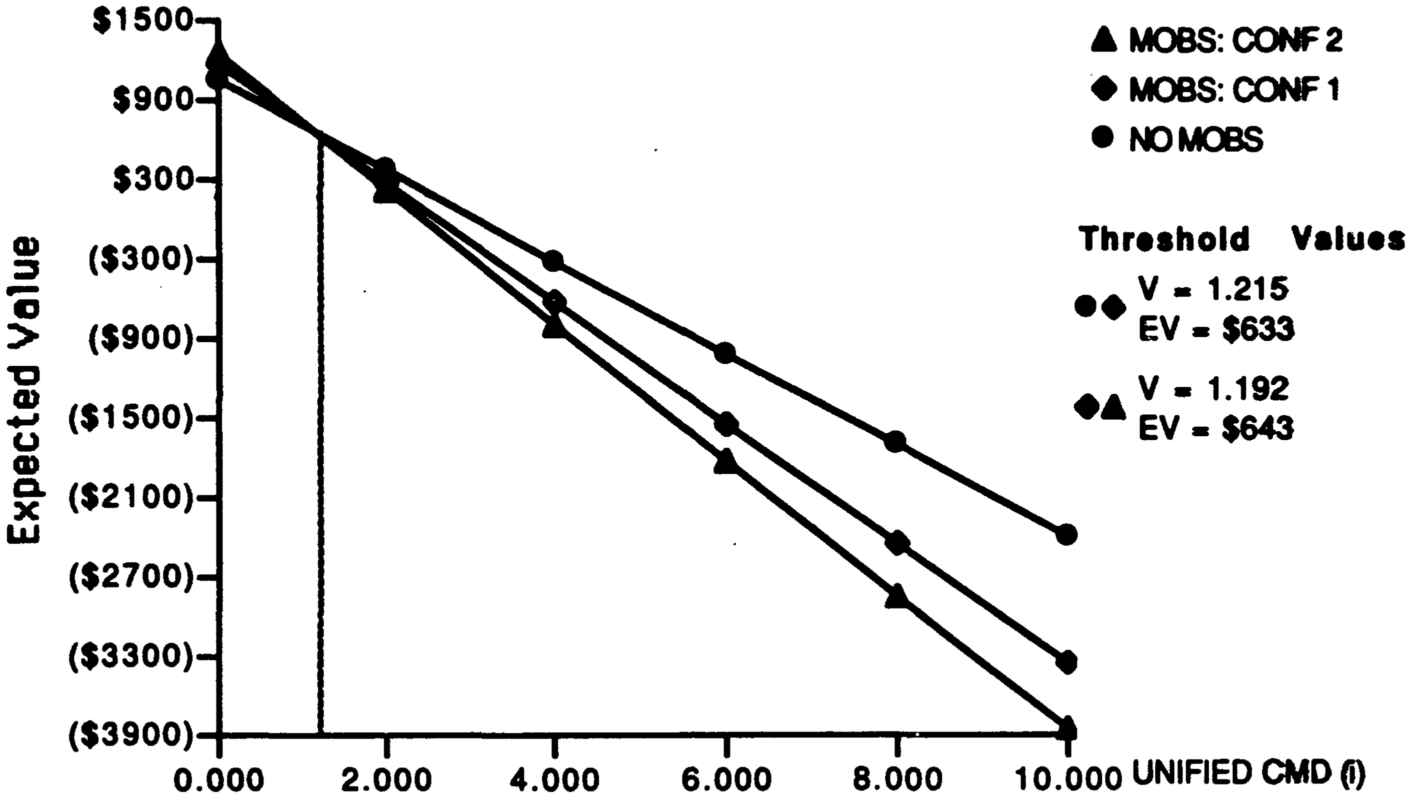
COMBINED HNS ECF	1187

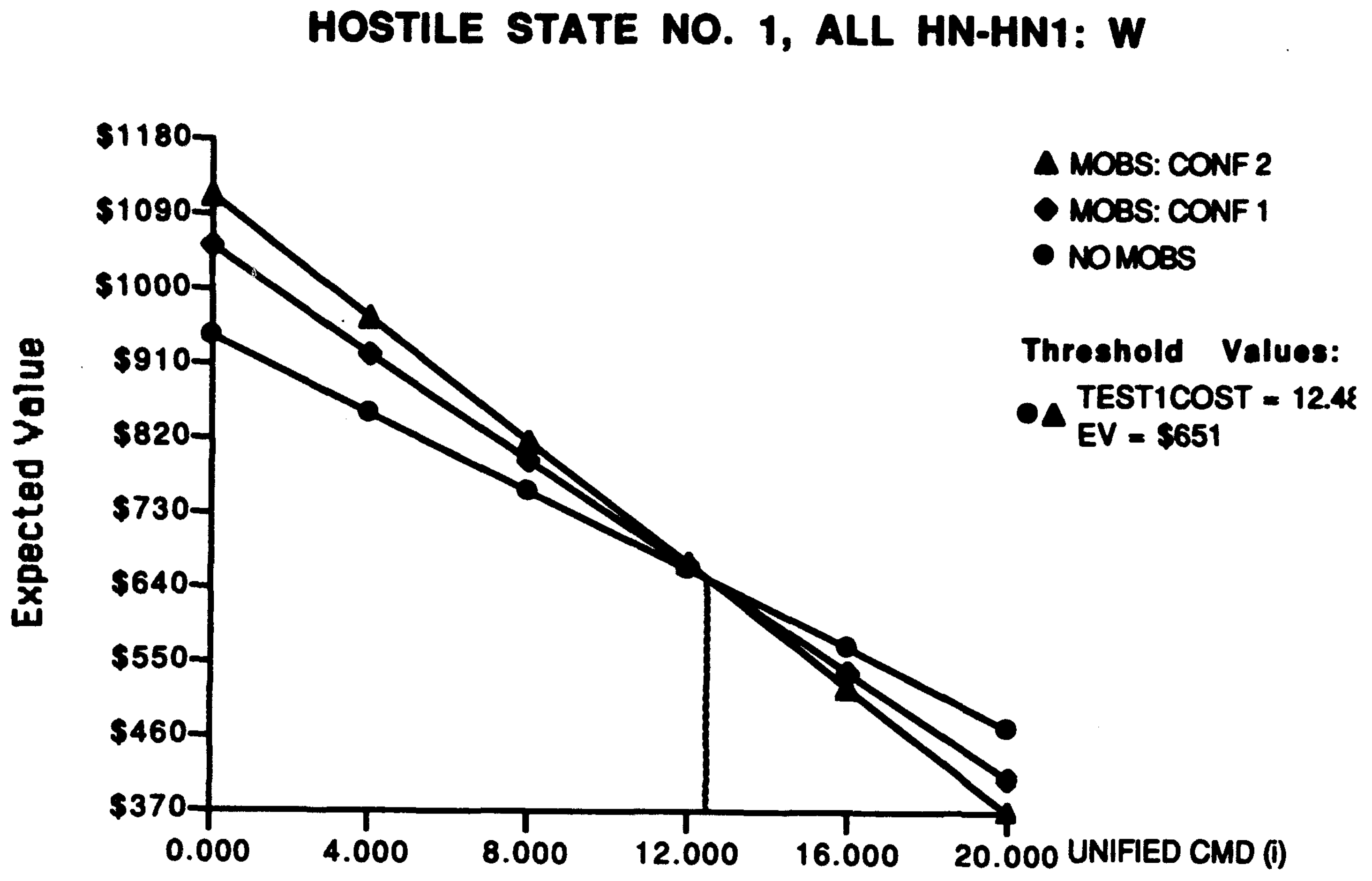
HNS PROBABILITY OF SUPPORT COMPILATION						EFF COMPILATION	
NONE	WPROB	STOL	WPROB	MM	WPROB		TAU
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
1.00	0.57	1.00	0.57	1.00	0.57	682	1.00
0.00	0.00	0.00	0.00	0.00	0.00	371	1.00
	0.69		0.69		0.69	1187	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.80	0.46	0.90	0.52	0.90	0.52	682	1.00
0.10	0.03	0.20	0.06	0.20	0.06	371	1.00
	0.60		0.69		0.69	1187	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.50	0.29	0.60	0.34	0.60	0.34	628	0.92
0.60	0.19	0.70	0.22	0.70	0.22	345	0.93
	0.59		0.68		0.68	1107	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.40	0.23	0.50	0.29	0.50	0.29	587	0.86
1.00	0.31	1.00	0.31	1.00	0.31	327	0.88
	0.66		0.71		0.71	1047	
1.00	0.11	1.00	0.11	1.00	0.11	134	1.00
0.20	0.11	0.30	0.17	0.30	0.17	546	0.80
1.00	0.31	1.00	0.31	1.00	0.31	308	0.83
	0.54		0.60		0.60	988	

					COST	ECF	ROLLBACK PROGRESSION		
			HNS	r 1					
		LEVEL	0.69	253	1440	1187	174		
		0.39	NO HNS	r 2				514	
			0.31	1090	1090	0	341		
			HNS	r 3					
		LEVEL	0.60	253	1440	1187	152		
		0.3	NO HNS	r 4				584	
			0.40	1090	1090	0	432		
			HNS	r 5					
	NO	LEVEL	0.59	333	1440	1107	196		
	MOBS	0.2	NO HNS	r 6				645	576
			0.41	1090	1090	0	449		
			HNS	r 7					
		LEVEL	0.66	393	1440	1047	257		
		0.1	NO HNS	r 8				633	
			0.34	1090	1090	0	376		
			HNS	r 9					
		LEVEL	0.54	452	1440	988	244		
		0.01	NO HNS	r 10				745	
			0.46	1090	1090	0	501		
			HNS	r 11					
		LEVEL	0.69	278	1542	1263	191		
		0.43	NO HNS	r 12				540	
			0.31	1116	1192	76	349		
			HNS	r 13					
		LEVEL	0.69	278	1542	1263	193		
		0.32	NO HNS	r 14				536	
			0.31	1116	1192	76	343		
			HNS	r 15					
UNIFIED	MOBS	LEVEL	0.68	359	1542	1183	243		
CDR	STOL	0.19	NO HNS	r 16				604	557
			0.32	1116	1192	76	361		
			HNS	r 17					
		LEVEL	0.71	422	1542	1120	301		
		0.05	NO HNS	r 18				622	
			0.29	1120	1192	72	322		
			HNS	r 19					
		LEVEL	0.60	485	1542	1057	290		
		0.01	NO HNS	r 20				741	
			0.40	1123	1192	69	451		
			HNS	r 21					
		LEVEL	0.69	293	1611	1318	201		
		0.45	NO HNS	r 22				555	
			0.31	1130	1261	131	353		
			HNS	r 23					
		LEVEL	0.69	293	1611	1318	203		
		0.34	NO HNS	r 24				550	
			0.31	1130	1261	131	348		
			HNS	r 25					
	MOBS	LEVEL	0.68	373	1611	1238	253		
	MM	0.17	NO HNS	r 26				618	568
			0.32	1130	1261	131	366		
			HNS	r 27					
		LEVEL	0.71	434	1611	1177	310		
		0.03	NO HNS	r 28				635	
			0.29	1132	1261	130	325		
			HNS	r 29					
		LEVEL	0.60	499	1611	1112	298		
		0.01	NO HNS	r 30				756	
			0.40	1137	1261	124	457		


HOSTILE STATE 1
COMBINED HOST NATION SUPPORT
HOST NATIONS 2 & 3 ONLY
UNIFIED CMD (I)
NO MOBS : 709.1645
NO MOBS
709.1645
LEVEL 1
0.010
HNS (k)
0.650
EQUIV_COSTS3 = 161.7400; P = 0.007
NO HNS (k)
0.350
EQUIV_COSTS3 = 865.0000; P = 0.004
LEVEL 2
0.100
HNS (k)
0.550
EQUIV_COSTS3 = 232.9580; P = 0.055
NO HNS (k)
0.450
EQUIV_COSTS3 = 865.0000; P = 0.045
LEVEL 3
0.200
HNS (k)
0.540
EQUIV_COSTS3 = 409.5020; P = 0.108
NO HNS (k)
0.460
EQUIV_COSTS3 = 865.0000; P = 0.092
LEVEL 4
0.300
HNS (k)
0.610
EQUIV_COSTS3 = 586.0460; P = 0.183
NO HNS (k)
0.390
EQUIV_COSTS3 = 865.0000; P = 0.117
LEVEL 5
0.390
HNS (k)
0.480
EQUIV_COSTS3 = 778.1430; P = 0.187
NO HNS (k)
0.520
EQUIV_COSTS3 = 865.0000; P = 0.203
MOBS: CONF 1
730.1792
LEVEL 1
0.040
HNS (k)
0.650
EQUIV_COSTS3 = 187.5440
NO HNS (k)
0.350
EQUIV_COSTS3 = 890.8040
LEVEL 2
0.120
HNS (k)
0.650
EQUIV_COSTS3 = 258.7620
NO HNS (k)
0.350
EQUIV_COSTS3 = 890.8040
LEVEL 3
0.210
HNS (k)
0.640
EQUIV_COSTS3 = 465.6844
NO HNS (k)
0.360
EQUIV_COSTS3 = 921.1824
LEVEL 4
0.280
HNS (k)
0.680
EQUIV_COSTS3 = 653.6203
NO HNS (k)
0.320
EQUIV_COSTS3 = 932.5743
LEVEL 5
0.350
HNS (k)
0.550
EQUIV_COSTS3 = 860.9065
NO HNS (k)
0.450
EQUIV_COSTS3 = 947.7635
MOBS: CONF 2
742.5544
LEVEL 1
0.050
HNS (k)
0.650
EQUIV_COSTS3 = 202.1630
NO HNS (k)
0.350
EQUIV_COSTS3 = 905.4230
LEVEL 2
0.130
HNS (k)
0.650
EQUIV_COSTS3 = 273.3810
NO HNS (k)
0.350
EQUIV_COSTS3 = 905.4230
LEVEL 3
0.230
HNS (k)
0.640
EQUIV_COSTS3 = 476.0904
NO HNS (k)
0.360
EQUIV_COSTS3 = 931.5684
LEVEL 4
0.260
HNS (k)
0.680
EQUIV_COSTS3 = 678.7998
NO HNS (k)
0.320
EQUIV_COSTS3 = 957.7536
LEVEL 5
0.330
HNS (k)
0.550
EQUIV_COSTS3 = 897.0622
NO HNS (k)
0.450
EQUIV_COSTS3 = 983.9192

HOSTILE STATE NO.1, ALL HN-HN1:V




HOSTILE STATE NO. 1, ALL HN-HN1: W
Expected Value
$1180
$1090
$1000
$910
$820
$730
$640
$550
$460
$370
0.000
4.000
8.000
12.000
16.000
20.000
UNIFIED CMD (i)
MOBS: CONF 2
MOBS: CONF 1
NO MOBS
Threshold Values:
TEST1COST = 12.4
EV = $651

HOSTILE STATE NO. 1	COMBINED HOST NATIONS W/OUT HN1

ANNUAL COSTS CHART (In millions)				
CATEGORY	FIXE	PERMIT	O&	TOTAL
HNS				1215
		PROCURE	O&	
MOBS: STOL	N/A	$36.75	$65.00	$101.75
MOBS: MULTIMS	N/A	$66.25	$105.00	$171.25

NOTE: Procurement cost for MOBS spread over 20 years

EQUIVALENT CUBIC FEET (In millions)					NETWORK
CATEGORY	L. CARGO	D. CARGO	PERS	TOTAL	VALUE
HNS				323.260	73
MOBS: STOL	2.278	3.582	0.086	5.946	7
MOBS: MULTIMS	4.556	6.098	0.173	10.827	12

CONFLICT LEVEL	CONFLICT LEVEL PROBABILITY			HNS PROBABILITY			TAU PROBABILITY		
	MOBS CONFIGURATION			MOBS CONFIGURATION			MOBS CONFIGURATION		
	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS
LEVEL 1	0.01	0.04	0.05	0.65	0.65	0.65	1	1	1
LEVEL 2	0.1	0.12	0.13	0.55	0.65	0.65	1	1	1
LEVEL 3	0.2	0.21	0.23	0.54	0.64	0.64	1	0.6	0.8
LEVEL 4	0.3	0.28	0.26	0.61	0.68	0.68	1	0.45	0.6
LEVEL 5	0.39	0.35	0.33	0.48	0.55	0.55	1	0.25	0.4
CHECK	1	1	1						

W=	10
V=	1

	RESULTS BY DECISION AND CONFLICT LEVEL					CUM. HNS	FINA
	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	PRO	RESUL
NO MOBS	409.52	515.25	621.20	694.45	823.15	0.54	709.22
STOL	435.33	477.85	631.83	743.95	900.28	0.62	730.85
MULTIMS	449.95	492.47	642.24	769.13	936.44	0.62	743.23

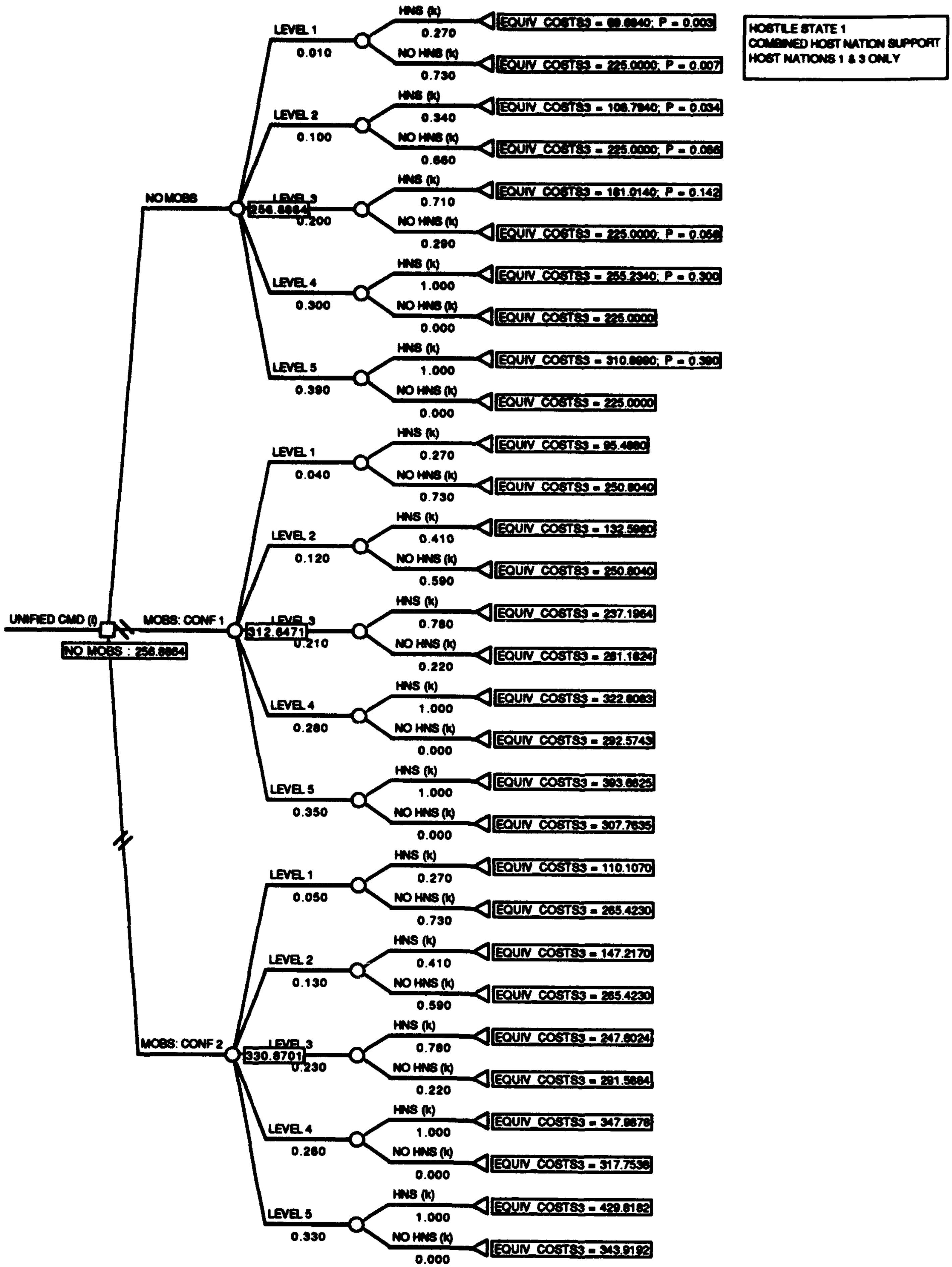
COMBINED HOST NATION DATA COMPILATION

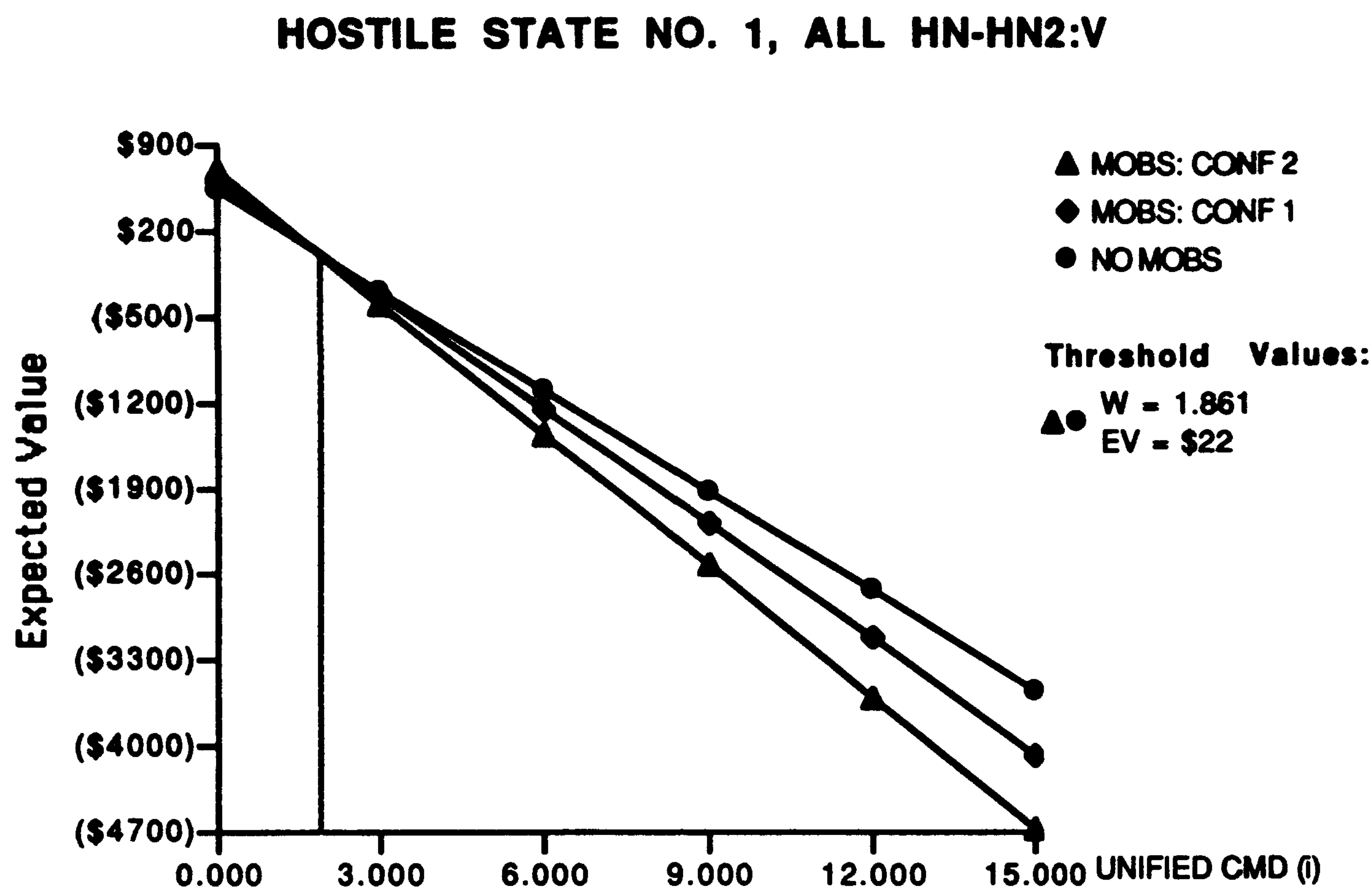
	COSTS	ECF	NV
HN1	0	0	0
HN2	865	252	43
HN3	350	71	30
TOTAL	1215	323	73

COMBINED HNS ECF	1053

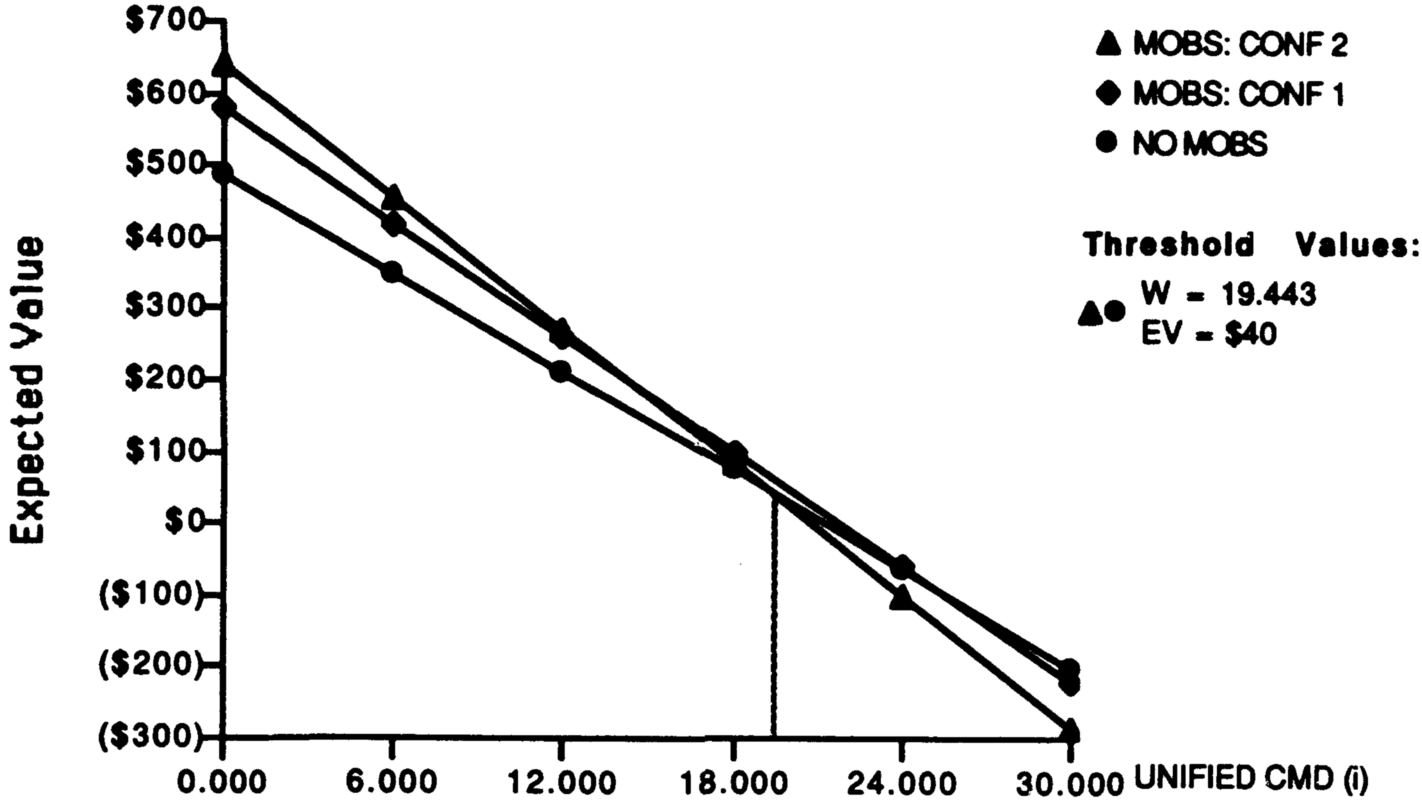
HNS PROBABILITY OF SUPPORT COMPILATION						EFF COMPILATION	
NONE	WPROB	STOL	WPROB	MM	WPROB		TAU
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
1.00	0.65	1.00	0.65	1.00	0.65	682	1.00
0.00	0.00	0.00	0.00	0.00	0.00	371	1.00
	0.65		0.65		0.65	1053	
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.80	0.52	0.90	0.58	0.90	0.58	648	0.95
0.10	0.04	0.20	0.07	0.20	0.07	334	0.90
	0.55		0.65		0.65	982	
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.50	0.32	0.60	0.39	0.60	0.39	546	0.80
0.60	0.21	0.70	0.25	0.70	0.25	260	0.70
	0.54		0.64		0.64	805	
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.40	0.26	0.50	0.32	0.50	0.32	443	0.65
1.00	0.35	1.00	0.35	1.00	0.35	186	0.50
	0.61		0.68		0.68	629	
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.20	0.13	0.30	0.19	0.30	0.19	307	0.45
1.00	0.35	1.00	0.35	1.00	0.35	130	0.35
	0.48		0.55		0.55	437	

					COST	ECF	ROLLBACK PROGRESSION		
			HNS	r 1					
		LEVEL	0.65	162	1215	1053	105		
		0.01	NO HNS	r 2				410	
			0.35	865	865	0	305		
			HNS	r 3					
		LEVEL	0.55	233	1215	982	129		
		0.1	NO HNS	r 4				515	
			0.45	865	865	0	386		
			HNS	r 5					
	NO	LEVEL	0.54	410	1215	805	219		
	MOBS	0.2	NO HNS	r 6				621	709
			0.46	865	865	0	402		
			HNS	r 7					
		LEVEL	0.61	586	1215	629	358		
		0.3	NO HNS	r 8				694	
			0.39	865	865	0	336		
			HNS	r 9					
		LEVEL	0.48	778	1215	437	375		
		0.39	NO HNS	r 10				823	
			0.52	865	865	0	448		
			HNS	r 11					
		LEVEL	0.65	188	1317	1129	121		
		0.04	NO HNS	r 12				435	
			0.35	891	967	76	314		
			HNS	r 13					
		LEVEL	0.65	259	1317	1058	169		
		0.12	NO HNS	r 14				478	
			0.35	891	967	76	309		
			HNS	r 15					
UNIFIED	MOBS	LEVEL	0.64	466	1317	851	296		
CDR	STOL	0.21	NO HNS	r 16				632	731
			0.36	921	967	46	336		
			HNS	r 17					
		LEVEL	0.68	654	1317	663	442		
		0.28	NO HNS	r 18				744	
			0.32	933	967	34	302		
			HNS	r 19					
		LEVEL	0.55	861	1317	456	471		
		0.35	NO HNS	r 20				900	
			0.45	948	967	19	430		
			HNS	r 21					
		LEVEL	0.65	202	1386	1184	131		
		0.05	NO HNS	r 22				450	
			0.35	905	1036	131	319		
			HNS	r 23					
		LEVEL	0.65	273	1386	1113	179		
		0.13	NO HNS	r 24				492	
			0.35	905	1036	131	314		
			HNS	r 25					
	MOBS	LEVEL	0.64	476	1386	910	302		
	MM	0.23	NO HNS	r 26				642	743
			0.36	932	1036	105	340		
			HNS	r 27					
		LEVEL	0.68	679	1386	707	459		
		0.26	NO HNS	r 28				769	
			0.32	958	1036	78	310		
			HNS	r 29					
		LEVEL	0.55	897	1386	489	490		
		0.33	NO HNS	r 30				936	
			0.45	984	1036	52	446		


HOSTILE STATE 1
COMBINED HOST NATION SUPPORT
HOST NATIONS 1 & 3 ONLY
UNIFIED CMD (I)
NO MOBS : 256.6864
NO MOBS
256.6864
LEVEL 1
0.010
HNS (k)
0.270
EQUIV_COSTS3 = 69.6840; P = 0.003
NO HNS (k)
0.730
EQUIV_COSTS3 = 225.0000; P = 0.007
LEVEL 2
0.100
HNS (k)
0.340
EQUIV_COSTS3 = 108.7940; P = 0.034
NO HNS (k)
0.660
EQUIV_COSTS3 = 225.0000; P = 0.066
LEVEL 3
0.200
HNS (k)
0.710
EQUIV_COSTS3 = 161.0140; P = 0.142
NO HNS (k)
0.290
EQUIV_COSTS3 = 225.0000; P = 0.058
LEVEL 4
0.300
HNS (k)
1.000
EQUIV_COSTS3 = 255.2340; P = 0.300
NO HNS (k)
0.000
EQUIV_COSTS3 = 225.0000
LEVEL 5
0.390
HNS (k)
1.000
EQUIV_COSTS3 = 310.8880; P = 0.390
NO HNS (k)
0.000
EQUIV_COSTS3 = 225.0000
MOBS: CONF 1
312.6471
LEVEL 1
0.040
HNS (k)
0.270
EQUIV_COSTS3 = 95.4660
NO HNS (k)
0.730
EQUIV_COSTS3 = 250.8040
LEVEL 2
0.120
HNS (k)
0.410
EQUIV_COSTS3 = 132.5960
NO HNS (k)
0.590
EQUIV_COSTS3 = 250.8040
LEVEL 3
0.210
HNS (k)
0.780
EQUIV_COSTS3 = 237.1964
NO HNS (k)
0.220
EQUIV_COSTS3 = 281.1624
LEVEL 4
0.280
HNS (k)
1.000
EQUIV_COSTS3 = 322.8083
NO HNS (k)
0.000
EQUIV_COSTS3 = 292.5743
LEVEL 5
0.350
HNS (k)
1.000
EQUIV_COSTS3 = 393.6625
NO HNS (k)
0.000
EQUIV_COSTS3 = 307.7635
MOBS: CONF 2
330.8701
LEVEL 1
0.050
HNS (k)
0.270
EQUIV_COSTS3 = 110.1070
NO HNS (k)
0.730
EQUIV_COSTS3 = 265.4230
LEVEL 2
0.130
HNS (k)
0.410
EQUIV_COSTS3 = 147.2170
NO HNS (k)
0.590
EQUIV_COSTS3 = 265.4230
LEVEL 3
0.230
HNS (k)
0.780
EQUIV_COSTS3 = 247.6024
NO HNS (k)
0.220
EQUIV_COSTS3 = 291.5684
LEVEL 4
0.260
HNS (k)
1.000
EQUIV_COSTS3 = 347.9878
NO HNS (k)
0.000
EQUIV_COSTS3 = 317.7538
LEVEL 5
0.330
HNS (k)
1.000
EQUIV_COSTS3 = 429.8182
NO HNS (k)
0.000
EQUIV_COSTS3 = 343.9192


HOSTILE STATE NO. 1, ALL HN-HN2:V
Expected Value
$900
$200
($500)
($1200)
($1900)
($2600)
($3300)
($4000)
($4700)
0.000
3.000
6.000
9.000
12.000
15.000
UNIFIED CMD (i)
MOBS: CONF 2
MOBS: CONF 1
NO MOBS
Threshold Values:
W = 1.861
EV = $22

HOSTILE STATE NO.1, ALL HN-2:W



HOSTILE STATE NO. 1	COMBINED HOST NATIONS W/OUT HN2

ANNUAL COSTS CHART (in millions)				
CATEGORY	FIXE	PERMIT	O&	TOTAL
HNS				575
		PROCURE	O&	
MOBS: STOL	N/A	$36.75	$65.00	$101.75
MOBS: MULTIMS	N/A	$66.25	$105.00	$171.25

NOTE: Procurement cost for MOBS spread over 20 years

EQUIVALENT CUBIC FEET (in millions)					NETWORK
CATEGORY	L. CARGO	D. CARGO	PERS	TOTAL	VALUE
HNS				85.316	42
MOBS: STOL	2.278	3.582	0.086	5.946	7
MOBS: MULTIMS	4.556	6.098	0.173	10.827	12

CONFLICT LEVEL	CONFLICT LEVEL PROBABILITY			HNS PROBABILITY			TAU PROBABILITY		
	MOBS CONFIGURATION			MOBS CONFIGURATION			MOBS CONFIGURATION		
	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS
LEVEL 1	0.01	0.04	0.05	0.27	0.27	0.27	1	1	1
LEVEL 2	0.1	0.12	0.13	0.34	0.41	0.41	1	1	1
LEVEL 3	0.2	0.21	0.23	0.71	0.78	0.78	1	0.6	0.8
LEVEL 4	0.3	0.28	0.26	1.00	1.00	1.00	1	0.45	0.6
LEVEL 5	0.39	0.35	0.33	1.00	1.00	1.00	1	0.25	0.4
CHECK	1	1	1						

						W=	10
						V=	1
	RESULTS BY DECISION AND CONFLICT LEVEL					CUM. HNS	FINA
	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	PRO	RESUL
NO MOBS	183.75	184.92	193.94	255.23	310.90	0.87	256.94
STOL	209.55	202.05	246.89	322.81	393.66	0.85	312.64
MULTIMS	224.17	216.66	257.29	347.99	429.82	0.84	330.87

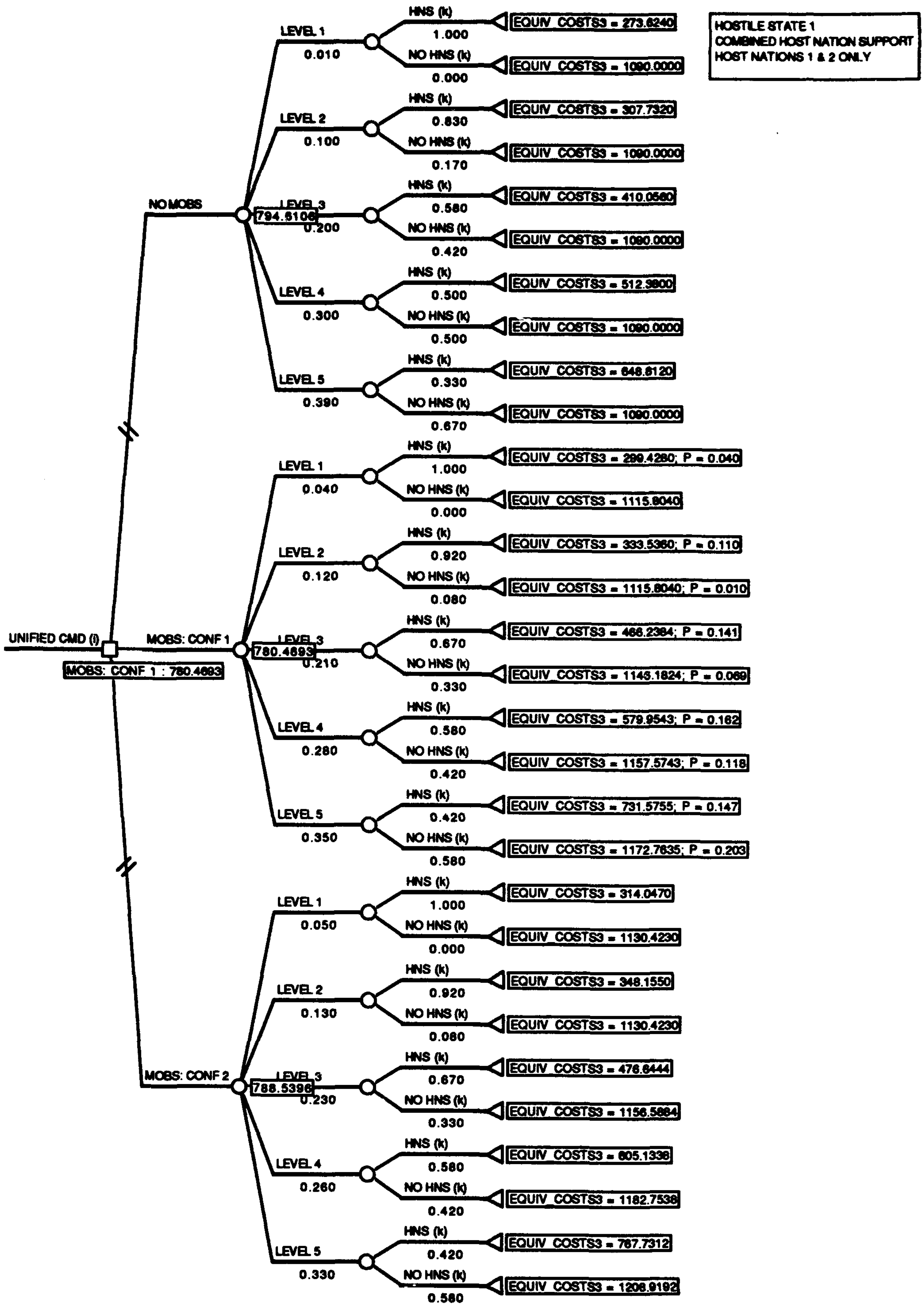
COMBINED HOST NATION DATA COMPLATION

	COSTS	ECF	NV
HN1	225	14	12
HN2	0	0	0
HN3	350	71	30
TOTAL	575	85	42

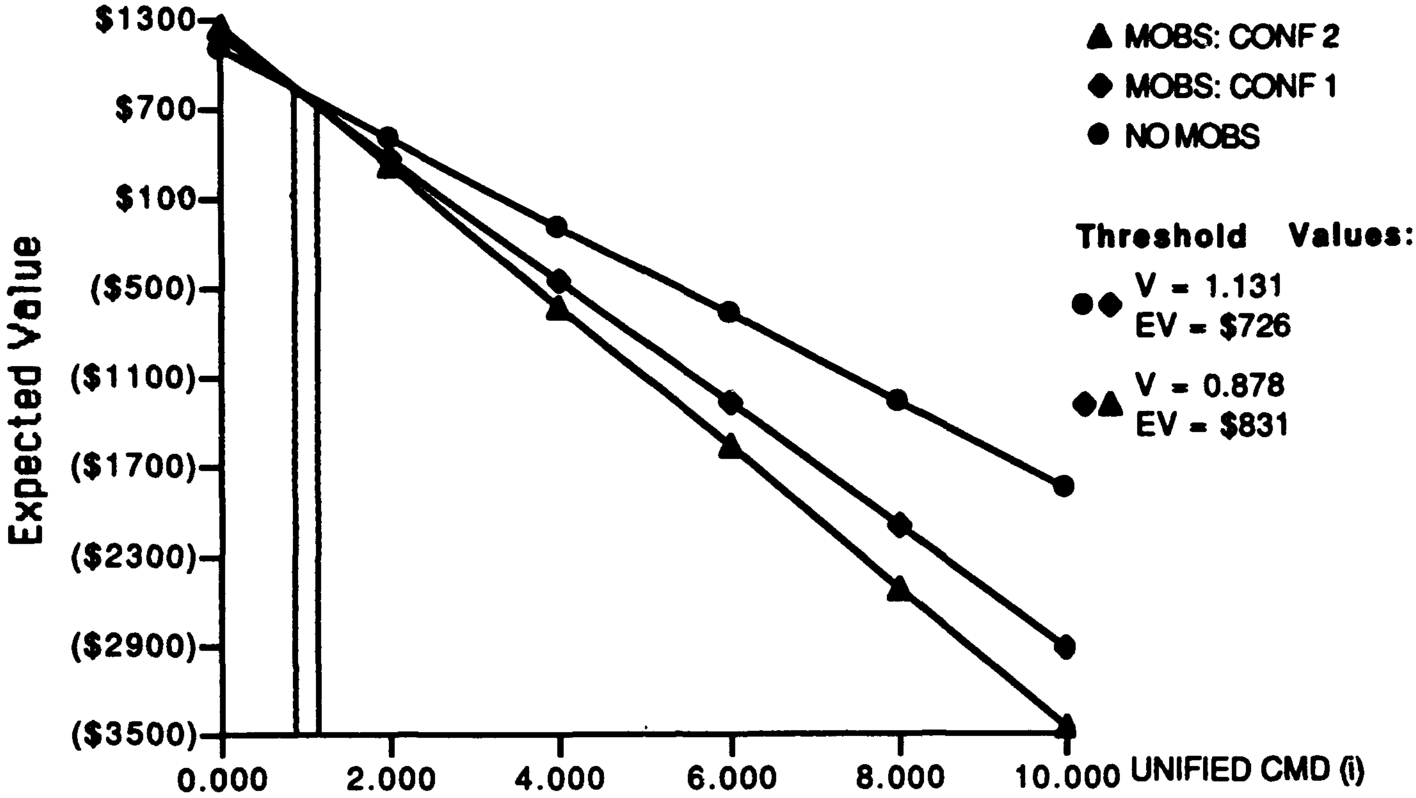
COMBINED HNS ECF	505

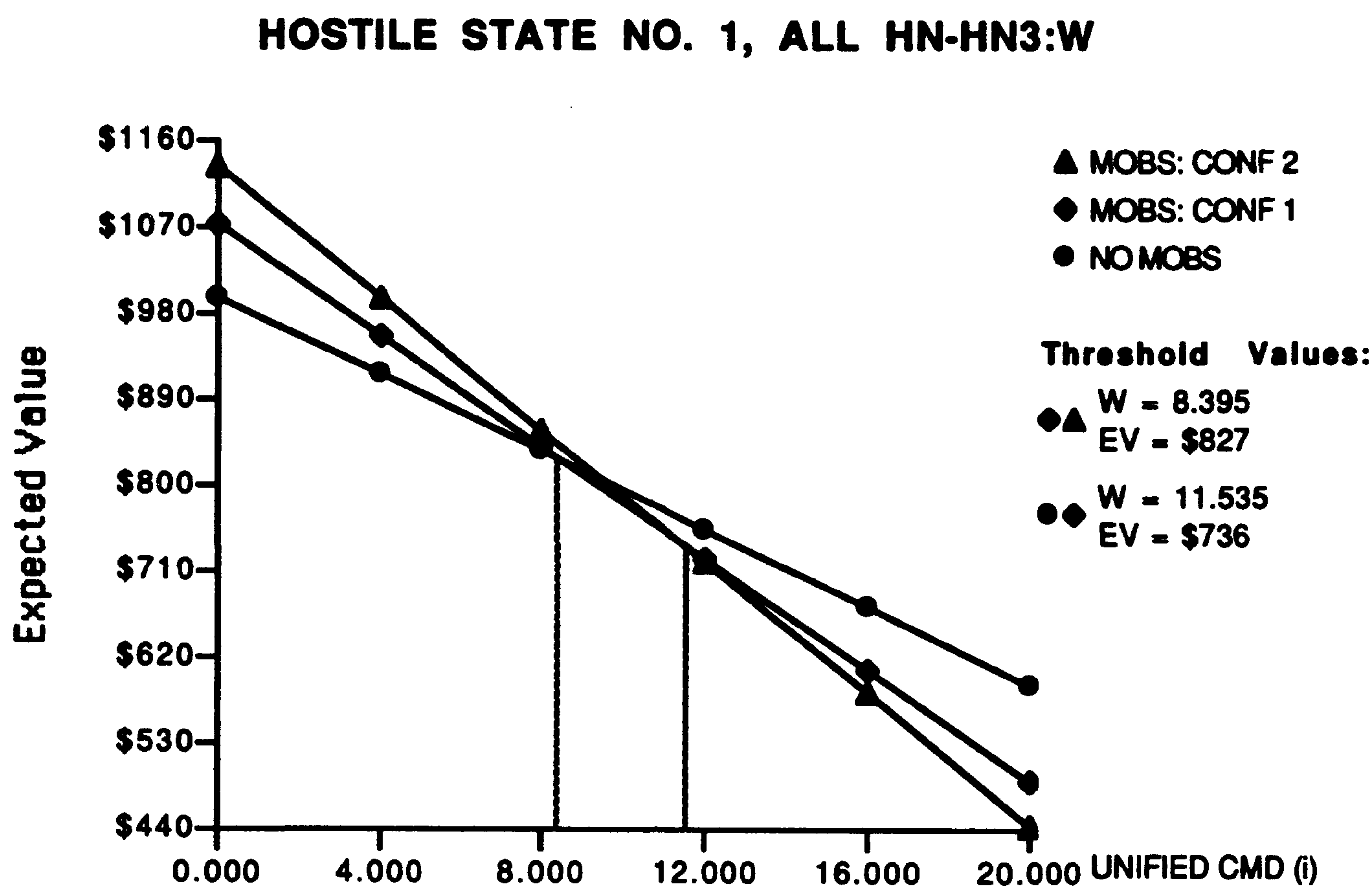
HNS PROBABILITY OF SUPPORT COMPLATION						EFF COMPLATION	
NONE	WPROB	STOL	WPROB	MM	WPROB		TAU
1.00	0.27	1.00	0.27	1.00	0.27	134	1.00
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.00	0.00	0.00	0.00	0.00	0.00	371	1.00
	0.27		0.27		0.27	505	
1.00	0.27	1.00	0.27	1.00	0.27	134	1.00
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.10	0.07	0.20	0.15	0.20	0.15	334	0.90
	0.34		0.41		0.41	468	
1.00	0.27	1.00	0.27	1.00	0.27	134	1.00
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
0.60	0.44	0.70	0.51	0.70	0.51	260	0.70
	0.71		0.78		0.78	394	
1.00	0.27	1.00	0.27	1.00	0.27	134	1.00
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
1.00	0.73	1.00	0.73	1.00	0.73	186	0.50
	1.00		1.00		1.00	320	
1.00	0.27	1.00	0.27	1.00	0.27	134	1.00
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
1.00	0.73	1.00	0.73	1.00	0.73	130	0.35
	1.00		1.00		1.00	264	

					COST	ECF	ROLLBACK PROGRESSION		
			HNS	r 1					
		LEVEL	0.27	70	575	505	19		
		0.01	NO HNS	r 2				184	
			0.73	225	225	0	165		
			HNS	r 3					
		LEVEL	0.34	107	575	468	36		
		0.1	NO HNS	r 4				185	
			0.66	225	225	0	149		
			HNS	r 5					
	NO	LEVEL	0.71	181	575	394	128		
	MOBS	0.2	NO HNS	r 6				194	257
			0.29	225	225	0	66		
			HNS	r 7					
		LEVEL	1.00	255	575	320	255		
		0.3	NO HNS	r 8				255	
			0.00	225	225	0	0		
			HNS	r 9					
		LEVEL	1.00	311	575	264	311		
		0.39	NO HNS	r 10				311	
			0.00	225	225	0	0		
			HNS	r 11					
		LEVEL	0.27	95	677	581	25		
		0.04	NO HNS	r 12				210	
			0.73	251	327	76	184		
			HNS	r 13					
		LEVEL	0.41	133	677	544	55		
		0.12	NO HNS	r 14				202	
			0.59	251	327	78	147		
			HNS	r 15					
UNIFIED	MOBS	LEVEL	0.78	237	677	440	185		
CDR	STOL	0.21	NO HNS	r 16				247	313
			0.22	281	327	46	62		
			HNS	r 17					
		LEVEL	1.00	323	677	354	323		
		0.28	NO HNS	r 18				323	
			0.00	293	327	34	0		
			HNS	r 19					
		LEVEL	1.00	394	677	283	394		
		0.35	NO HNS	r 20				394	
			0.00	308	327	19	0		
			HNS	r 21					
		LEVEL	0.27	110	746	636	29		
		0.05	NO HNS	r 22				224	
			0.73	265	396	131	195		
			HNS	r 23					
		LEVEL	0.41	147	746	599	61		
		0.13	NO HNS	r 24				217	
			0.59	265	396	131	156		
			HNS	r 25					
	MOBS	LEVEL	0.78	248	746	499	193		
	MM	0.23	NO HNS	r 26				257	331
			0.22	292	396	105	64		
			HNS	r 27					
		LEVEL	1.00	348	746	398	348		
		0.26	NO HNS	r 28				348	
			0.00	318	396	78	0		
			HNS	r 29					
		LEVEL	1.00	430	746	316	430		
		0.33	NO HNS	r 30				430	
			0.00	344	396	52	0		


HOSTILE STATE 1
COMBINED HOST NATION SUPPORT
HOST NATIONS 1 & 2 ONLY
UNIFIED CMD (i)
MOBS: CONF 1 : 780.4693
NO MOBS
794.6106
MOBS: CONF 1
780.4693
MOBS: CONF 2
788.5396
LEVEL 1
0.010
HNS (k)
1.000
EQUIV COSTS3 = 273.6240
NO HNS (k)
0.000
EQUIV COSTS3 = 1090.0000
LEVEL 2
0.100
HNS (k)
0.830
EQUIV COSTS3 = 307.7320
NO HNS (k)
0.170
EQUIV COSTS3 = 1090.0000
LEVEL 3
0.200
HNS (k)
0.580
EQUIV COSTS3 = 410.0560
NO HNS (k)
0.420
EQUIV COSTS3 = 1090.0000
LEVEL 4
0.300
HNS (k)
0.500
EQUIV COSTS3 = 512.3800
NO HNS (k)
0.500
EQUIV COSTS3 = 1090.0000
LEVEL 5
0.390
HNS (k)
0.330
EQUIV COSTS3 = 648.8120
NO HNS (k)
0.670
EQUIV COSTS3 = 1090.0000
LEVEL 1
0.040
HNS (k)
1.000
EQUIV COSTS3 = 289.4280; P = 0.040
NO HNS (k)
0.000
EQUIV COSTS3 = 1115.8040
LEVEL 2
0.120
HNS (k)
0.920
EQUIV COSTS3 = 333.5360; P = 0.110
NO HNS (k)
0.080
EQUIV COSTS3 = 1115.8040; P = 0.010
LEVEL 3
0.210
HNS (k)
0.670
EQUIV COSTS3 = 466.2384; P = 0.141
NO HNS (k)
0.330
EQUIV COSTS3 = 1145.1824; P = 0.069
LEVEL 4
0.280
HNS (k)
0.580
EQUIV COSTS3 = 579.9543; P = 0.162
NO HNS (k)
0.420
EQUIV COSTS3 = 1157.5743; P = 0.118
LEVEL 5
0.350
HNS (k)
0.420
EQUIV COSTS3 = 731.5755; P = 0.147
NO HNS (k)
0.580
EQUIV COSTS3 = 1172.7635; P = 0.203
LEVEL 1
0.050
HNS (k)
1.000
EQUIV COSTS3 = 314.0470
NO HNS (k)
0.000
EQUIV COSTS3 = 1130.4230
LEVEL 2
0.130
HNS (k)
0.920
EQUIV COSTS3 = 348.1550
NO HNS (k)
0.080
EQUIV COSTS3 = 1130.4230
LEVEL 3
0.230
HNS (k)
0.670
EQUIV COSTS3 = 476.6444
NO HNS (k)
0.330
EQUIV COSTS3 = 1156.5884
LEVEL 4
0.260
HNS (k)
0.580
EQUIV COSTS3 = 605.1338
NO HNS (k)
0.420
EQUIV COSTS3 = 1182.7538
LEVEL 5
0.330
HNS (k)
0.420
EQUIV COSTS3 = 767.7312
NO HNS (k)
0.580
EQUIV COSTS3 = 1208.9192

HOSTILE STATE NO.1, ALL HN-HN3:V





HOSTILE STATE NO. 1, ALL HN-HN3:W
$1160
$1070
$980
$890
$800
$710
$620
$530
$440
Expected Value
0.000
4.000
8.000
12.000
16.000
20.000
UNIFIED CMD (i)
MOBS: CONF 2
MOBS: CONF 1
NO MOBS
Threshold Values:
W = 8.395
EV = $827
W = 11.535
EV = $736

				COST	ECF	ROLLBACK PROGRESSION		
		HNS	r 1					
	LEVEL	1.00	274	1090	816	274		
	0.01	NO HNS	r 2				274	
		0.00	1090	1090	0	0		
		HNS	r 3					
	LEVEL	0.83	308	1090	782	256		
	0.1	NO HNS	r 4				438	
		0.17	1090	1090	0	182		
		HNS	r 5					
NO	LEVEL	0.58	416	1090	680	239		
MOBS	0.2	NO HNS	r 6				694	794
		0.42	1090	1090	0	455		
		HNS	r 7					
	LEVEL	0.50	512	1090	578	255		
	0.3	NO HNS	r 8				802	
		0.50	1090	1090	0	546		
		HNS	r 9					
	LEVEL	0.33	649	1090	441	215		
	0.39	NO HNS	r 10				944	
		0.67	1090	1090	0	729		
		HNS	r 11					
	LEVEL	1.00	299	1192	892	299		
	0.04	NO HNS	r 12				299	
		0.00	1116	1192	76	0		
		HNS	r 13					
	LEVEL	0.92	334	1192	858	306		
	0.12	NO HNS	r 14				399	
		0.08	1116	1192	76	93		
		HNS	r 15					
UNIFIED MOBS	LEVEL	0.67	466	1192	726	310		
CDR STOL	0.21	NO HNS	r 16				694	782
		0.33	1146	1192	46	383		
		HNS	r 17					
	LEVEL	0.58	580	1192	612	338		
	0.28	NO HNS	r 18				821	
		0.42	1158	1192	34	484		
		HNS	r 19					
	LEVEL	0.42	732	1192	460	304		
	0.35	NO HNS	r 20				990	
		0.58	1173	1192	19	686		
		HNS	r 21					
	LEVEL	1.00	314	1261	947	314		
	0.05	NO HNS	r 22				314	
		0.00	1130	1261	131	0		
		HNS	r 23					
	LEVEL	0.92	348	1261	913	319		
	0.13	NO HNS	r 24				414	
		0.08	1130	1261	131	94		
		HNS	r 25					
MOBS	LEVEL	0.67	477	1261	785	317		
MM	0.23	NO HNS	r 26				704	790
		0.33	1157	1261	105	387		
		HNS	r 27					
	LEVEL	0.58	605	1261	656	352		
	0.26	NO HNS	r 28				846	
		0.42	1183	1261	78	494		
		HNS	r 29					
	LEVEL	0.42	768	1261	494	319		
	0.33	NO HNS	r 30				1026	
		0.58	1209	1261	52	707		

HOSTILE STATE NO. 1	COMBINED HOST NATIONS W/OUT HN3

ANNUAL COSTS CHART (In millions)				
CATEGORY	FIXE	PERMIT	O&	TOTAL
HNS				1090
		PROCURE	O&	
MOBS: STOL	N/A	$36.75	$65.00	$101.75
MOBS: MULTIMS	N/A	$66.25	$105.00	$171.25

NOTE: Procurement cost for MOBS spread over 20 years

EQUIVALENT CUBIC FEET (In millions)					NETWORK
CATEGORY	L CARGO	D. CARGO	PERS	TOTAL	VALUE
HNS				266.376	55
MOBS: STOL	2.278	3.582	0.086	5.946	7
MOBS: MULTIMS	4.556	6.098	0.173	10.827	12

CONFLICT LEVEL	CONFLICT LEVEL PROBABILITY			HNS PROBABILITY			TAU PROBABILITY		
	MOBS CONFIGURATION			MOBS CONFIGURATION			MOBS CONFIGURATION		
	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS	NONE	STOL	MULTIMS
LEVEL 1	0.01	0.04	0.05	1.00	1.00	1.00	1	1	1
LEVEL 2	0.1	0.12	0.13	0.83	0.92	0.92	1	1	1
LEVEL 3	0.2	0.21	0.23	0.58	0.67	0.67	1	0.6	0.8
LEVEL 4	0.3	0.28	0.26	0.50	0.58	0.58	1	0.45	0.6
LEVEL 5	0.39	0.35	0.33	0.33	0.42	0.42	1	0.25	0.4
CHECK	1	1	1						

W=	10
V=	1

	RESULTS BY DECISION AND CONFLICT LEVEL					CUM. HNS	FINA
	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	PRO	RESUL
NO MOBS	273.62	438.46	694.14	801.97	943.74	0.49	794.06
STOL	299.43	398.90	693.50	821.28	989.63	0.60	781.81
MULTIMS	314.05	413.52	703.91	846.46	1025.79	0.61	789.95

COMBINED HOST NATION DATA COMPLATION

	COSTS	ECF	NV
HN1	225	14	12
HN2	865	252	43
HN3	0	0	0
TOTAL	1090	266	55

COMBINED HNS ECF	816

HNS PROBABILITY OF SUPPORT COMPLATION						EFF COMPLATION	
NONE	WPROB	STOL	WPROB	MM	WPROB		TAU
1.00	0.16	1.00	0.16	1.00	0.16	134	1.00
1.00	0.84	1.00	0.84	1.00	0.84	682	1.00
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
	1.00		1.00		1.00	816	
1.00	0.16	1.00	0.16	1.00	0.16	134	1.00
0.80	0.67	0.90	0.75	0.90	0.75	648	0.95
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
	0.83		0.92		0.92	782	
1.00	0.16	1.00	0.16	1.00	0.16	134	1.00
0.50	0.42	0.60	0.50	0.60	0.50	546	0.80
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
	0.58		0.67		0.67	680	
1.00	0.16	1.00	0.16	1.00	0.16	134	1.00
0.40	0.33	0.50	0.42	0.50	0.42	443	0.65
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
	0.50		0.58		0.58	578	
1.00	0.16	1.00	0.16	1.00	0.16	134	1.00
0.20	0.17	0.30	0.25	0.30	0.25	307	0.45
0.00	0.00	0.00	0.00	0.00	0.00	0	0.00
	0.33		0.42		0.42	441	

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